AVIATION WEEK

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Aviation Week

ABC Member ABC

Volume 55 **August 27, 1951** **Number 9**

Special Report on ALPA—IV.....63

Headline News

Races Prove Air Power Appeal..... 13
Four-Place Helioplane Shown..... 15
Faster Write-Offs of Planes..... 17
CAR Review 18
Nonskeds' Operation Homelift..... 18
Battle Looms on C-46 Limits..... 19

Equipment

Stratos to Make French Turbine..... 51

Production Engineering

Why Planes Cost So Much..... 23
New French Navy Aircraft..... 30
Wilderness Lab Serves Avro..... 33
Brabazon Design Changes..... 37
Design Study: Canberra Mk. 2..... 44
NACA Reports 47

Air Transport

ALPA to Press Mileage Issue..... 63
Decision 83 64
ATA Studies Pool of Carrier Parts.... 66
PAA Liberia Crash Cause Unknown.. 67
N. Y.-Havana Permit to Cubana..... 67

Departments

News Digest 9
Sidelights 10
Who's Where 11
Industry Observer 11
New Products 59
Also on the Market..... 59
USAF Contracts 60
Shortlines 68
Aviation Calendar 69
Picture Page 76
Letters 78

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IN THE NEWS

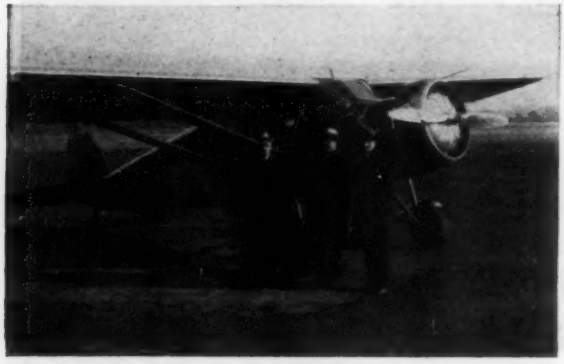
G-E FLIGHT TEST CENTER FINDS ANSWERS IN THE SKY

One of the biggest current programs, is an accelerated service test of G-E J47 engines in a North American B-45C, for the Air Force. This B-45 is one of the newest planes to join the Flight Test fleet.

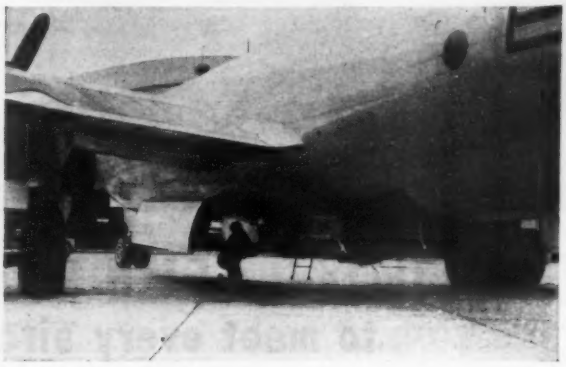
A sure way to test airborne equipment is in the air. So General Electric has established an invisible laboratory that stretches eight miles up into the sky.

At the bottom of this lab is the G-E Flight Test Center at the Schenectady, N. Y. County Airport. Here, a "private air force" is put through its paces with new and improved aircraft equipment. A division of the Company's General Engineering Laboratory, the Flight Test Center is devoted entirely to testing General Electric aviation equipment *in the air*.

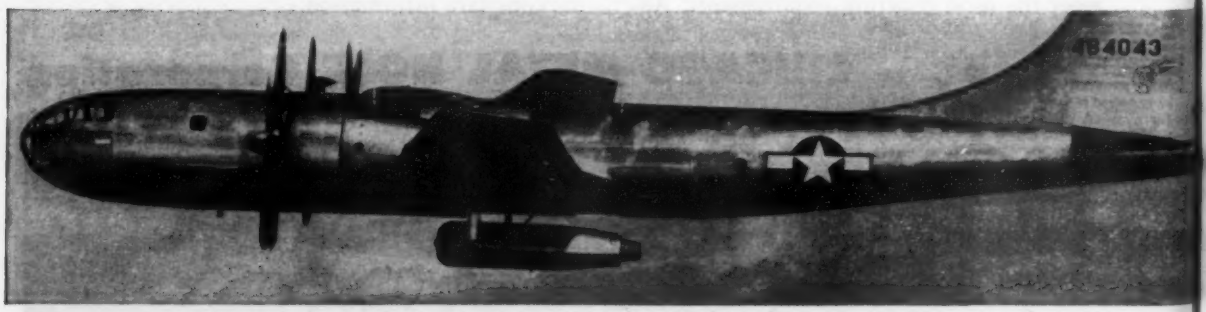
G-E's program of designing, testing, redesigning, retesting means better, more reliable equipment for you.



Ed Haven, left, now manager of G-E's Aviation Divisions, beside G-E's first airplane, back in 1930. Prior to this purchase, equipment was tested in a monoplane rented for a dollar a minute. Foresight of men like Haven made possible the extensive facilities now in use.



New engines and components are tested thoroughly while slung from the bomb bay of a B-29. Here a J47-GE-23, powerful new jet recently placed in production, is made ready in the Flying Test Bed. New engine control, anti-icing, and ignition systems were first proved and improved in this plane.



A B-29 is pushed along by a standard J47, specially instrumented for test work. Many engine features and pilot techniques first checked out here, are now being combat-proved in Korea. American Airlines crews, under contract to G-E, perform all flight operations.

Long distance wires and radio-telephones keep engineers in G-E's Aircraft Gas Turbine Divisions in Lynn, Mass., in contact with the crew in the test plane. Weldon Orme, at the Test Center, talks to Lynn (200 miles east) with the phone in his left hand, and the B-29 (eight miles up) with the phone in his right hand.

Special instrument panels in test aircraft are photographed four times per second. Cameras and instrument panels were specially designed for this purpose. After each flight the films are studied minutely to gain all possible information on operation of the engines.

Many types of aircraft are used. This B-23 tested high-altitude turbosuperchargers during the war. Cabin pressurizing from turbos, developed on this plane, is now in use on many military craft as well as on some commercial transports.

One of many projects at the Center has been a jet powerplant for a developmental helicopter. A 150-foot bowl served as a test pit for "Operation Skyhook." Ramjet, pulsejet, and turbojet engines are tested here.

The G-E stable of planes includes many loaned by the government as well as Company-owned craft. Closely guarded, the Flight Test Center tests armament, instruments, autopilots, radar, electronics and communications equipment, electrical systems, and other aircraft equipment, in addition to aircraft powerplants.

GENERAL ELECTRIC

210-24

PIONEER AIR LINES' fleet of thirteen DC-3's, flies better than 350,000 plane miles a month. Since its inauguration, Pioneer has flown more than 450,000 persons some 130 million passenger miles, in addition to handling large volumes of air mail, air express and air freight. *Engines of all Pioneer planes are lubricated exclusively with Texaco Aircraft Engine Oil*—"A big factor," says Pioneer, "in keeping our flights on schedule and our maintenance costs low."

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FOR THE AVIATION INDUSTRY

NEWS DIGEST

DOMESTIC

Russian Il-10 being tested at Wright-Patterson AFB suffered minor damage when it belly-landed after a recent test flight at Dayton. The landing gear is believed to have folded on touch-down. Further evaluation will depend on whether replacement parts, particularly new tires, can be obtained.

New atomic shielding materials have been developed at Oak Ridge, Tenn., laboratories, which should aid in development of atomic-powered aircraft. A release from the laboratories revealed that work on two programs on shielding phenomena and materials has shown definite progress.

Maj. Charles E. Yeager, USAF, first man to fly faster than sound, has been named "airman of the year" and winner of the General "Hap" Arnold Memorial Trophy by 110 air cadets from 14 countries, now in this country under international cadet exchange of the Civil Air Patrol.

Personal and executive plane exports for July of planes of 6,000 lb. and less, empty airframe weight totaled 34 valued at $194,028 by nine companies. Previous month 38 planes worth $229,201 were exported.

Temporary airframe industry bottleneck has been caused by failure of NPA to allocate aluminum ingot for castings in September and part of October.

Three top USAF generals got new assignments. Maj. Gen. Francis L. Ankenbrandt becomes assistant chief of staff, communications, Allied Air Forces Central Europe. He was previously Director of Communications, Deputy Chief of Staff, Operations, in Washington, D. C. Maj. General Raymond C. Maude, commanding general of the 1009th Special Weapons Sqdrn., Washington, D. C., will take Gen. Ankenbrandt's former post. Brig. Gen. Donald J. Keirn, director of research, Air Research and Development Command, Baltimore, Md., takes command of the 1009th.

TWA's maintenance base in Kansas City, hard hit by last month's floods, will be back to near-normal by the end of this week, when the first Connie rolls in for overhaul. Flooded offices were almost ruined, will not be in operation until the end of next month.

First modified Convair T-29 navigator-bombardier trainer (military Convair-Liner) has been delivered to the USAF. Changes include increase of gross weight from 40,500 lb. to 43,575 lb.; outer wing fuel tankage capacity increased to 1,500 gal., and installation of new radar training gear.

Gen. Carl A. Spaatz Airport is new name for Reading Municipal Airport, Reading, Pa., rededicated Aug. 12.

FINANCIAL

United Aircraft Corp. reports net income of $6,307,992 for the first six months of 1951 after federal income taxes. This compares with a net of $6,432,136 for the same period last year. The corporation noted that total contracts, orders and letters of intent at June 30 were about $1,185 million for its several divisions.

Mid-Continent Airlines turned in a net profit of $133,600 in the first half of this year, after taxes, compared to $154,284 last year in the same period. A reported net loss of $48,424 on its local service route, after allowance for tax saving attributable to the loss, reduced MCA's net profit to $85,176. Operating revenues in the first half were $4,620,484.

Sperry Corp. directors have declared a quarterly dividend of 50 cents per share, payable Sept. 24 to stockholders of record on Sept. 7.

INTERNATIONAL

Three Douglas DC-6Bs—seating 50—have been ordered by Canadian Pacific Lines for delivery late in 1952. CPL will become 22nd operator of DC-6s.

British European Airways has inaugurated turboprop aircraft freight service using two Rolls-Royce Dart-powered Douglas C-47 Dakotas, making four round trips weekly between London and Hanover, Germany. The flights are to give BEA crews experience with the Dart, which is also fitted in the Vickers Viscounts the line has ordered.

Prime Minister Attlee is scheduled to open the International Air Transport Assn.'s annual general meeting in London Sept. 10.

IATA Clearing House, London, has handled $75,303,000 in transactions during the first half of this year for international airlines, more than $9 million over similar period last year.

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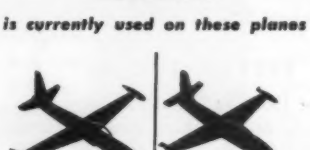
See condensed literature in 1951 I.A.S. Aeronautical Engineering Catalog or write for Bulletin 118.

ROTORette

is currently used on these planes



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SIDELIGHTS

Industry

► **Maj. Gen. Gordon P. Saville** (USAF, Ret.) will become a consultant to Consolidated Vultee for about three months and then is slated to join the staff of Republic Aviation Corp.

► **Negotiations last week** by Curtiss-Wright Corp. for acquisition of Otis Elevator Co.'s Buffalo works plant indicated a second milestone in C-W's expansion in the metal-working industry. The plant in adjacent to Buffalo Stainless Casting Corp., which C-W's new Metal Process division took over in July to make jet engine blades. The new plant will make castings and other metal products used in jets.

► **Chase Aircraft Co.** disclosed an eight-man board of directors with Henry J. Kaiser as chairman. Members: Edgar Kaiser, president of Chase; Michael Stroukoff, Chase founder, now vice president and chief engineer; Michael Miller, vice president of Kaiser-Frazer, Inc., as vice president; J. X. Cousins, treasurer and comptroller; William F. Sauers, secretary; Franklin S. Wood, New York City attorney, and E. E. Trefethen, executive vice president of Kaiser Industries.

► **Canadair, Ltd.,** Montreal, has received a $3.4-million order for repair and reconditioning of RCAF planes and engines.

Transport

► **CAB wants to renew the economic regulation** most hated by Alaskan bush pilots. It would prohibit "Alaskan pilot-owners" from flying at all on any route that one or more scheduled carriers serve "on an aggregate of three or more scheduled flights weekly." The proposal is to extend Regulation 292.8 for five years from Dec. 31, 1951.

► **A free airlift of relief supplies** for Korea is proposed to nonscheduled airlines from U. S. airports to West Coast shipping embarkation points. Roy Chalk, president of Trans-Caribbean Airways, made the suggestion as president of Independent Military Air Transport Assn.

Civil Aviation

► **This is the last week** that pilots, mechanics and other "airmen" can go at their business legally without new CAA airman aviation identification cards. Deadline is Sept. 1 for getting new certificate. Applicants must report to CAA safety agent with two face-view passport-type identical photos which must have been taken within the past 12 months, plus proof of identity and citizenship. Fingerprints will be taken. CAA says proof of citizenship and identity is easiest with a World War II CAA identification card. Other means include birth or baptism certificate or a passport.

► **CAA has issued** a 15-cent "Personal Aircraft Owner's Guide" of 18 pages, answering questions most frequently asked CAA by plane owners.

► **Continuing its demonstration tour,** CAA's prototype AG-1 agricultural plane performs

Aug. 28 for Flying Farmers Assn. at Ft. Worth. From there it goes to Kansas City, Seattle and Los Angeles. It has already flown 4,180 miles and 147 pilots have tried it out.

Procurement

▶ **Small businesses** looking for defense contracts will get a first hand look at products needed by prime contractors at an exhibit in Atlanta's Hotel Biltmore Sept. 10-12.

Services

▶ **Washington Backstop Services** have been established by Richard N. Cowell at 1028 Connecticut Ave., to offer either day-to-day or emergency business services to industry. Cowell was formerly on public relations staffs of Curtiss-Wright and Ivy Lee, and is an ex-newspaperman in the capital.

WHO'S WHERE

In the Front Office

J. P. Orchard has been named new president of the Fort Wayne division of Bowser, Inc., succeeding **E. C. Marsh**, who resigned effective Aug. 31, after 42¼ years of service with the company. Orchard joined the firm at Fort Wayne in 1940, previously was a management consultant.

Changes

John H. Swartz has been promoted to chief engineer of Linear, Inc., Philadelphia, Pa.

Charles F. Peach has been designated chief radar engineer on design and analysis for Zenith Plastics Co., Gardena, Calif.

C. J. (Jack) Irvine has been appointed assistant division manager and chief engineer of the Convair Guided Missile division, and **Harold W. Pope** has been made assistant chief engineer.

Antonio Ferri, formerly head of the gas dynamics branch of NACA's Langley Laboratory, has been made professor of aerodynamics at the Polytechnic Institute, Brooklyn, N. Y.

Herbert L. Brown has been appointed director of materials for Pacific Airmotive Corp., Burbank, Calif.

Harold B. Ridgley and **Paris F. Young** have been promoted to assistant superintendents of Texas Engineering & Mfg. Corp., Dallas, and **F. C. Stouffer** has been designated assistant superintendent of overhaul production. **Boyd Draper** has been named superintendent in charge of production of Luscombe Airplane Corp.

On the Board

Robert E. Caskey has been elected to the board of directors of California Eastern Airways. He continues as vice president of West Coast operations for the same organization.

Weekly picture page appears on p. 76

INDUSTRY OBSERVER

▶ **Electronics bugs in the complicated armament system of the Boeing six-jet B-47 bomber are causing trouble. But Emerson Electric and General Electric engineers are about to exterminate the bugs, Pentagon sources say. At latest report rearward-firing protective cannon of the medium jet bomber were still inoperative due to difficulties which have been encountered in tests undertaken with the fire control system mechanism.**

▶ Jet fuel for the Red Air Force in Germany is being produced at V. E. B. Boehlen near Leipzig. It is designated DLD. Also at Boehlen and at nearby Zwickau, fuel for reciprocating engines, designated HLK, is being produced.

▶ **Air Force 1952 fiscal year estimates call for expenditure of $179.4 million for ground handling equipment for airplanes, including $72 million for bomber equipment, $64.8 million for fighter equipment, and $35.4 million for transport equipment.**

▶ Three groups of Russian MiG-15 interceptors have been assigned to the East German air fields at Gaartz and Peenemunde to defend the Red missile center at Peenemunde. Meanwhile orders to reinforce runways at Brand-Briesen to accommodate the Russian TU-4 bombers (Red copy of the U. S. B-29) add strength to reports that Soviet bomber groups are being moved to the German eastern zone.

▶ **Proposal to power 500 American-built F-86 Sabre airframes with British Rolls-Royce Avon engines, as a means of supplying the RAF quickly with a quantity of high-speed jet interceptors, is still far from dead. Some Pentagon sources say that if the engines could be supplied as fast as the airframes, the problem would be simple of solution. With spares, according to U. S. tables of supply, it would mean four or five engines for each single-engine fighter.**

▶ Price for the first four Boeing B-52 airplanes, reported by Air Force spokesmen as $21.3 million a plane, includes $50 million tooling cost (divided $12.5 million to the plane). There are still some indications that the first four may be all that will be produced at Seattle, or at least that any quantity B-52 production will be moved, possibly to Ft. Worth or Marietta, Ga. On the basis of production of 100 units or more of the eight-jet bomber, Air Force expects cost would be about $3.8 million apiece.

▶ **USAF is interested in the heavy forge press program because the method can be used to produce in single large pieces, components formerly assembled from several parts. At the new Wyman-Gordon drop-forging plant at North Grafton, Mass., an 80,000 meter-kilogram hammer shipped over from Germany recently knocked out in a single operation a complete landing gear strut column for a Convair B-36 bomber. The estimated combined time, weight, dollar saving was two-thirds over the cost of making the part in the old-fashioned conventional piecemeal method.**

▶ Beech Aircraft's twin-engine C-45 light transport of World War II is getting a new lease on life in 1952 USAF budget estimates. They call for modification and remanufacture of 933 of the C-45s at a total cost of $31 million or about $34,000 each. Also on the list for a "retrofit" are 175 of the relatively new postwar North American T-28 trainers, which will be re-equipped at a cost of $8,000 per plane.

▶ **Air Force plans to do 35,701 engine overhauls in its own depots, and contract for 8,197 commercially, making a total of 43,898, at a cost of $71.4 million. In justifying this cost to Congress, Air Force submitted costs of three of the most commonly used engines as $54,300 for the R-4360-41 used in the B-36; $24,300 for the R-3350-57 used in the B-29, and $16,400 for the R-1820.**

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J-54002

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AVIATION GAS TURBINES

AVIATION WEEK

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AUGUST 27, 1951

BENDIX TROPHY WINNER Col. Keith K. Compton, USAF, receives congratulations from Malcom P. Ferguson, Bendix Aviation president, for flying 1,919.6 mi. at 551.6 mph. in F-86-A.

THOMPSON TROPHY WINNER Col. Fred J. Ascani, USAF, and famed award given him by Fred Crawford, president of Thompson Products. Ascani set 100-km. mark—635.4 mph. in F-86-E.

Races Prove Crowd-Appeal of Air Power

Services' static exhibits and flight displays push attendance above 200,000 mark.

By Ben S. Lee

Detroit—One of the most complete public displays of this nation's air power yet shown was a top drawing card at the 24th annual National Air Races at Detroit Aug. 18-19.

A record turn-out of more than 200,000 people jammed highways leading to Detroit's Wayne Major Airport, and proved beyond all doubt—much to the surprise of the industry—that the nation had a definite interest in seeing just how well and for what its air defense tax dollars were being spent. Foreign interest was indicated by presence of 37 air attaches of other nations.

Although aircraft of all three services flew in demonstration and appeared in static display, Air Force was the chief exhibitor at the air classic resumed after a one-year lapse.

▶**AF Message**—Air Force apparently was just as interested in getting its dollars-for-air-power message across to the public as the public was in learning it. USAF displayed more of its armed might than it ever had before, including most of its latest fighters, bombers and transports, with, for the first time, complete armament.

The public was allowed to walk through some of the latest bombers and transports, to examine cockpits, controls and some details of armament and radar.

▶**Records Smashed**—The races saw three world's records set and for the first time all-jet participation in the major events on the program.

Air Force Col. Fred J. Ascani, 34, flying a North American F-86E Sabre smashed American and world speed records for the 100-km. (62 mi.) Thompson Trophy closed course race with an average speed of 635.411 mph. The new record was set during speed trials the day before the races actually got under way. The trial time was recorded by NAA officials and was permitted to stand when Ascani's later Air Race performance averaged only 628.698 mph. Both marks topped the previous record held by John Douglas Derry of Great Britain. Derry's mark of 605.230 was made Apr. 12, 1948, in a de Havilland 108 research plane.

▶**Military Participation**—Naval and Marine flight activity was restricted to flight demonstrations by reserve personnel. The late Admiral Forrest Sherman had ruled out major participation by the Navy in this year's National Air Races to eliminate any possible competitive friction between the services. But Naval officials attending the races decided that competition would be a healthy thing and next year the policy will probably be reversed.

Army gathered much of its aircraft equipment and demonstrated various helicopter and fixed-wing missions. It showed how artillery fire was adjusted; performed wire-laying; simulated evacuation of wounded, among other things.

All four major races—The Bendix, Thompson, Allison and General Electric—featured only USAF jet fighters and bombers. Most static displays were provided by the Air Force although there were many Navy exhibits on display, including the giant Lockheed Constitution and a Chance-Vought twin jet XF7U Cutlass fighter.

▶**Bendix Trophy Race**—Highlighting the first race day was the arrival of the Bendix Trophy Race participants from Muroc to Detroit. Competitors were two North American F-86E Sabres; three Republic F-84E Thunderjets and two North American B-45C four-engine light bombers.

Winner of the $25,000 competition was Col. Keith K. Compton who set a new record of 551.761 mph. in an F-86A during a 3-hr. 26-min. 56.4-sec. flight from Muroc to Detroit. Compton made the 1,919.6-mi. flight with

two 6-minute touch-downs at Denver and Omaha for refueling.

Compton's share in the Bendix classic would have been $15,000, but with military regulations forbidding cash awards to military personnel the entire $25,000 purse will be turned over to various military relief organizations.

Second place winner in the Bendix was Col. Emmett S. Davis who piloted an F-84E at an average speed of 534.847 mph. Third plane to cross the finish line was a North American B-45C light bomber piloted by Lt. Col. George Thiebault who made the transcontinental flight in 3 hr. 35 min.

Other pilots in the Bendix, in order of their arrival at Detroit, were: Capt. Bernard Watts (B-45, 3 hr. 35 min.); Capt. Edward R. Johnson (F-84, 3 hr. 19 min.); Maj. Gilbert A. Pederson (F-84, 3 hr. 46 min.).

Capt. Thomas V. Gibson, piloting a North American F-86 overshot the Detroit field at altitude and let down over Selfridge AFB, Mich. Because of dangerously low fuel supply, Gibson had to land at the air base and was disqualified. All of the Bendix participants figured their fuel reserves very closely during the race. Compton, for example, had less than 25 gal. when he touched down at Detroit.

After the race, Compton said that most of his transcontinental flight had been made at about 45,000 ft., and that during the letdown from Chicago to Detroit he had "flown a little better than 700 mph."

Speaking of his F-86 performance, Compton said, "It handled very well although the flight was a little turbulent. When the plane approached the speed of sound it had a tendency to 'curl up.' "

Previous record for the same race run at Cleveland in 1949 was 529.614 mph. It was held by Maj. Vernon Ford.

► **Allison Trophy Race**—Four Republic F-84E Thunderjets competed in the 500-mi. Indianapolis-Detroit dash which 1st Lt. William D. Baisley won with an average speed of 580.512 mph. Second place went to Col. William E. Bertram, and third to 1st Lt. Jacob Kratt.

While no serious accidents marred this year's race, Lt. Col. John W. Lafko, competing in the Allison classic, crash-landed his F-84 on takeoff with a "flame-out" of the engine just as the craft was becoming airborne. Lafko, native of Austin, Tex., escaped with a bruised knee and a wrenched back. He said that his plane was at approximately 145 mph. when the mishap occurred.

► **Continental Trophy Race**—Midget racing plane event for civilian craft and pilots was won by John Paul Jones of Van Nuys, Calif., with a record-breaking speed of 197.218 mph. The race was restricted to aircraft with an engine displacement of less than 190 cu. in.

► **Static Exhibit**—Many of the aircraft on static display were armed with dummy rockets and bombs shown publicly for the first time.

Navy showed Lockheed P2V Neptune, Grumman F8F Bearcat, Lockheed Constitution, Martin AM-1 Mauler, Chance-Vought XF7U Cutlass and a vast display of armament including rockets, bombs, machine guns, missiles, and assorted electronic devices and radar equipment.

Air Force Static exhibits included the Convair B-36, North American B-45, Douglas C-124, Fairchild XC-120, Republic F-84E, Boeing B-50 and radar and electronic equipment and armament. In addition there was a static cut-away B-36 that received considerable attention.

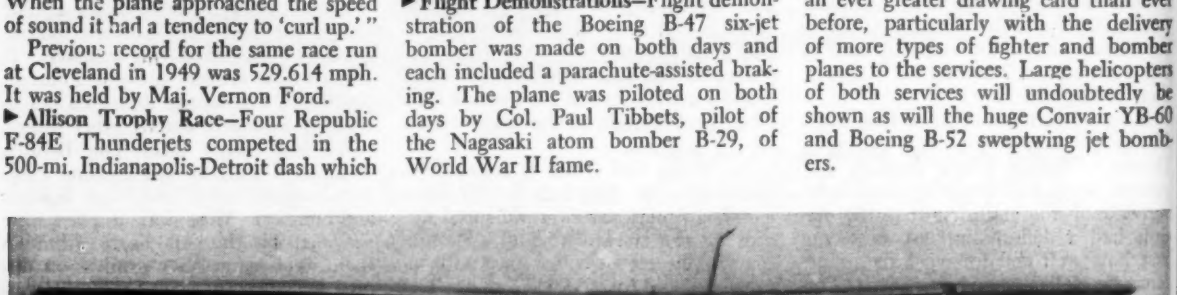
► **Flight Demonstrations**—Flight demonstration of the Boeing B-47 six-jet bomber was made on both days and each included a parachute-assisted braking. The plane was piloted on both days by Col. Paul Tibbets, pilot of the Nagasaki atom bomber B-29, of World War II fame.

Navy conducted a comparative climb demonstration between an F8F propeller-driven fighter and a McDonnell F2H-1 Banshee jet fighter. The F8F, holder of the world's record for climb to 10,000 ft. from a standing start (less than one minute) lived up to its record. The Banshee, after it got off, flew close to the ground until it gained speed and then caught up with and passed the Bearcat somewhere above 10,000 ft. The Banshee climbed right on up to about 45,000 ft. before leveling off.

Considerable interest was aroused in an Air Force demonstration showing utilization of the Chase YC-122 as a glider towed into a "battle area" by a Fairchild C-119. The YC-122 was then cut loose from the mother plane, cut in its engines, landed and discharged two jeeps, two drivers and two machine gunners. These latter started blasting at "enemy troops" with machine guns as the jeeps rolled out of the C-122. Immediately afterward, the plane's rear-ramp cargo doors slammed shut and the plane roared off the ground after a 400-ft. run with a two-bottle rato assist. The whole ground operation, from touch-down to takeoff lasted 55 sec.

Static exhibits were given considerable more prominence in this year's National Air Races than previously, and proved extremely popular with the average spectator. They similarly gave the manufacturer an opportunity to display his wares to the man who ultimately pays the bill.

With the promise of major Navy participation in next year's show, jet aircraft entries will probably prove to be an ever greater drawing card than ever before, particularly with the delivery of more types of fighter and bomber planes to the services. Large helicopters of both services will undoubtedly be shown as will the huge Convair YB-60 and Boeing B-52 sweptwing jet bombers.



CONSOLIDATED VULTEE'S GRASSHOPPER FREIGHTER

A highlight of Army Field Forces' display at the 1951 National Air Races was demonstration of how Convair L-13 could supply isolated troops with needed supplies. Pilot simply pulls a cord to release floats fastened to wing struts and cargo in cabin is shoved out. Plane's ability to fly at low speeds makes it particularly suited for the specialized job.

HELIO COURIER: Medium high speed, surprisingly low speed of 30 mph., and . . .

SIMPLE INTERIOR for four passengers.

Four-Place Helioplane Shown at Races

Unheralded debut vies for lightplane interest with midget racers.

By Alexander McSurely

Detroit—A thumbnail report on the 1951 National Air Races would be:

- **Speed,** plus
- **Acrobatic performances,** plus.
- **Static show,** plus.
- **Spectator facilities,** mediocre.
- **Staging,** obviously temporary and minimum cost.

Then, to this appraisal, you can add one factor which ten years from now may be all that the old gaffers of aviation will remember about the 1951 races: It was the year when they first introduced the four-place slow-flying helioplane, an aircraft that just might revolutionize civil air transportation.

The trim, red helioplane Courier, making its debut at Wayne County Major Airport in a sneak preview without advance ballyhoo won considerable military and civilian aviation attention as it crawled through the air at around 30 mph. and then stepped up to 150 mph.

Its success or failure depends now on:

- **Materials.** Whether its developers can get through the formidable materials squeeze which is choking a number of promising aviation ideas.
- **Liaison.** Whether Army aviation and Air Force procurement can get together on a proposal to order a liaison version.

▶**High-Lift Devices**—The helioplane Courier has a 260-hp. Lycoming GO-435 engine with reduction gear turning an aeromatic propeller, but the secret of its performance is in its high-lift wing devices, incorporated in the design by Prof. Otto Koppen of Massachusetts Institute of Technology. He developed the plane to performance specifications laid down by Dr. Lynn Bollinger (now on leave from the faculty of Harvard Business School to serve as president of Helio Aircraft Corp.). The high-lift devices include full-span flaps and leading-edge slats.

The production prototype attains approximately the same slow flying performance as the two-place No. 1 helioplane, but has been redesigned to permit use of a readily available engine and propeller combination and to meet some anticipated industrial and military requirements. Bollinger told AVIATION WEEK that he expects to test its marketing appeal around Detroit within the next few weeks, with a view to producing some custom-built models for the armed services and possibly for a few business man customers before trying a larger production program.

The plane can be adapted to carry six persons at some sacrifice of the specialized slow-flight performance which makes it possible for it to operate from

National Air Race Results

Bendix Trophy Jet Race

(Edwards AFB, Muroc, Calif. to Detroit (1919.6 mi.))

Pilot	Plane	Speed mph.
Col. K. K. Compton	F-86A	551.761
Col. E. S. Davis....	F-84E	534.847
Lt. Col. G. B. Thabault	B-45	532.637

Allison Trophy Jet Race

(Detroit to Indianapolis to Detroit)

Pilot	Plane	Speed mph.
Lt. W. D. Baisley..	F-84-E	580.512
Lt. Col. W. E. Bertram	F-84-E	572.395
Lt. Jacob Kratt Jr..	F-84-E	521.825

Thompson Trophy Jet Speed Run

(100 kilometer (62.14 mi.) closed course)

Pilot	Plane	Speed mph.
Col. Fred J. Ascani	F-86E	628.698

(Note: Same pilot and plane set new world closed course 100 km. record of 635.411 mph. Aug. 17)

Chicago-Detroit Jet Speed Run

Pilot	Plane	Speed mph.
Capt. Omer J. Reichman	F-86A	672.189

Continental Motors Trophy Finals

(90 hp. midget planes, flying 15 laps of 2½ mi. six pylon course)

Pilot	Plane	Speed mph
John Paul Jones	Shoestring	197.218
Steve Wittman	Bonzo	192.174
Keith Sorenson	Smith Special	187.476

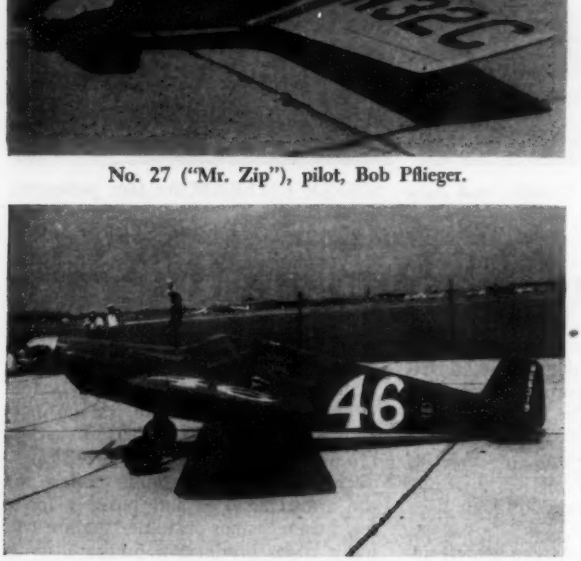
National Parachute Jumping Contest

Robert L. Nolan, Cave Junction, Oregon won over Sgt. G. A. Weckerle, Ft. Lee, Va. in finals.

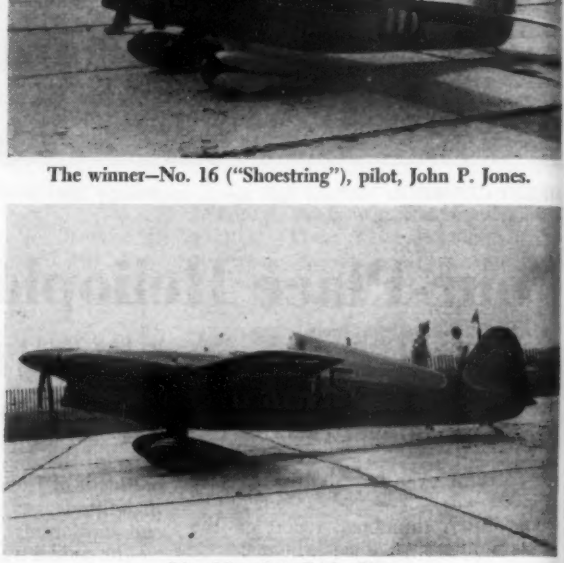
Among 1951 Continental Trophy Entries

No. 27 ("Mr. Zip"), pilot, Bob Pflieger.

The winner—No. 16 ("Shoestring"), pilot, John P. Jones.

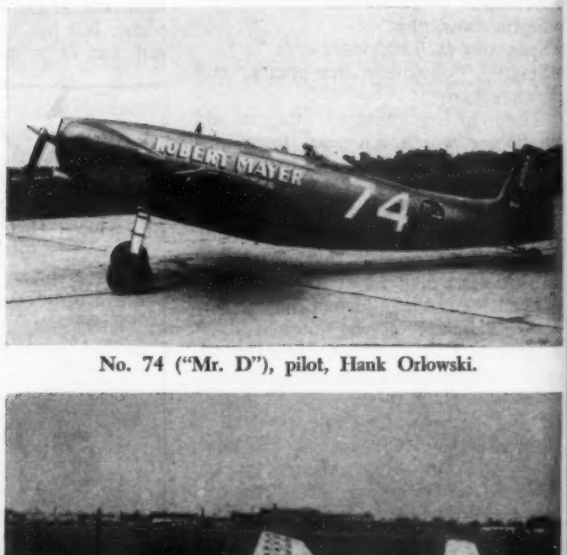


No. 46, pilot, Joe Mangano.



No. 15, pilot, Dick Ohm.

No. 8 ("Lil Monster"), pilot, Bill Brennand.



No. 74 ("Mr. D"), pilot, Hank Orlowski.

No. 9 ("Mammy"), pilot, Kip More.

No. 87, pilot, Bob Beckington.

tiny in-town or plant-side landing areas, about football-field size, with normal load.

Examination of the experimental Courier at Detroit showed it has the practical left-front door and right-rear door combination arrangement used by Piper on the Clipper and Pacer. Cabin appears roomy and well-appointed with excellent visibility. Metal wing and tail surfaces and metal forward cabin section are joined by a fabric-covered rear fuselage section of welded tubing.

▶**Continental Races**—Last remnant of the professional pilot's major league sprints for cash, the midget plane races sponsored by Continental Motors Corp., saw another advance in speed this year. The fleetest of the 90-hp. racers set a new record of 197.218 mph. The plane was "Shoestring" piloted by John Paul Jones, Van Nuys, Calif., pilot who also won the 1950 Continental Trophy at Detroit's International Air Fair.

Veteran school teacher-pilot Sylvester (Steve) Wittman, of Oshkosh, Wis., got his "Bonzo" revved up to 192.174 mph. to take second place ahead of Keith Sorenson, La Crescenta, Calif., who had 187.476 mph. for the third-place time.

In qualification, Jones had just missed the 200-mph. mark by a fraction, taking the pole position with a 199.778-mph. top speed.

Most unconventional midget plane in the races, the Par Special from St. Louis, which uses a pusher propeller and a single-wheel landing gear, finished well back in a consolation event, after failing to gain qualification for the finals.

▶**Speed Advances**—Indicative of how speeds have advanced since the first major midget race conducted at Cleveland under Goodyear sponsorship in 1947 are these figures:

- 1947—Bill Brennand won with 165.-857 mph.
- 1948—H. R. Salmon won with 169.-608 mph.
- 1949—Brennand won again with 177.-34 mph.

The continental races were seriously marred from a spectator viewpoint because of the great distance between the spectators and the racing planes. The racers appeared little bigger than so many models from the closest boxes and could hardly be seen at all from bleacher seats with the naked eye.

▶**Aerobatics**—Precision solo aerobatics by the still youthful "old master", Beverly Howard; by the current international champion, Rod Jocelyn, and by the women's champion, Caro Bayley, provided the frosting on the air-race cake to many of the spectators.

Military jet formation flying by an RCAF team in Vampires, and by a USAF foursome of "Acrojets" in Lockheed F-80s was of a very high order also.

Most hair-raising flying of the old "blood and guts" air show type was done by the three Cole brothers, who flew formation loops and other maneuvers with their biplanes, with a man strapped upright to a support on the upper wing of each craft.

▶**Near Misses**—For those morbid individuals in the crowd who came to see somebody killed, the show was a disappointment. But there were some near misses; twice when two parachutist competitors were carried into the spectator area by the wind, and once when an F-84 jet fighter's engine flamed out on takeoff and the pilot landed in an adjoining field, narrowly missing cars and spectators. None of these three were seriously hurt.

The big Wayne County Airport is far superior to Cleveland National Airport as a staging ground for the National Air Races as far as natural layout is concerned. But the Cleveland spectator facilities, developed over years of operation seem much better, in retrospect at least than the temporary Detroit ones. These could stand considerable improvement if another show is to be held there, as has been indicated, next year.

Merger Move Seen For NAA, NAC

Merger of two major national aviation organizations, National Aeronautic Assn. and National Air Council will probably take place soon.

The merger movement began at NAA's annual convention, in Detroit, which authorized a committee to negotiate with a similar NAC committee on joining forces. The NAA committee is: Dr. John Victory, chairman; William McCracken; Gill Robb Wilson; Harry Coffey; and Col. Roscoe Turner. NAC's committee will be named shortly. The two committees expect to meet early in September.

The NAA delegates stipulated, however, that NAA is to retain its identity.

Donald D. Webster, Washington insurance executive, was elected president. Webster is now president of the Aero Club of Washington and commander of the National Capitol Wing of Civil Air Patrol. Other officers named were: Roger Wolfe Kahn, vice president, for FAI activities; Lt. Gen. Ira C. Eaker, vice president, for national defense; Edward C. Sweeney, vice president, for air youth; Adm. Emory S. Land, vice president, for air transport; John Curry, vice president, for soaring, and Mrs. Mary E. Brown, secretary.

Louis E. Leverone, past president, will continue to serve as an NAA director.

Faster Write-Offs Of Planes Sought

Seven airlines have asked for Defense Production Administration certificates to permit accelerated tax amortization on over $83 million of airline equipment. But unlike the railroads, which moved a year ago, when the going was easier, the airlines have moved too late to take full, if any, advantage of the tax benefits permitted for defense expansion.

American Airlines' and Trans World Airlines' applications are the test case up for Defense Production Administration decision at Byron D. Woodside's Division of Defense Expansion of DPA. American asks accelerated write-off on five new Convair-Liners. TWA asked for speed-up write-off on 76 planes including Martin 4-0-4s and Constellations, but the Commerce Department is claiming for only 26 of those TWA planes at DPA, now. Commerce is holding onto the other five airlines' applications for results of the American-TWA test case.

Commerce Undersecretary Delos Rentzel met with DPA officials last week to present more detail on the case of the airlines asking accelerated amortization.

Result is that last week chances of establishing a precedent allowing airlines to make accelerated write-off on some planes appeared "reasonably favorable."

▶**Arguments Against**—Here are some arguments given against permitting any airline to accelerate write-off on transports, according to Don L. Carroll, Woodside's assistant at the DPA division:

- **Airplanes don't carry much** freight volume compared to railroads, especially essential steel and raw materials.
- **Aviation equipment already has such** rapid amortization tax write-off that a certificate permitting five-year instead of seven-year write-off is not important.
- **Granting American's application** would set a precedent; DPA wants to be careful about establishing any new precedents.

Now Defense Mobilizer Charles E. Wilson has sent DPA a new directive declaring a 60-day moratorium on issuing certificates. The Wilson directive tightens the standards by which DPA is to judge which capital expansion rates accelerated tax amortization, and how much. Last week DPA Administrator Manly Fleischmann was working on an interpretation of the Wilson policy directive, and until the new policies are interpreted at DPA, there will be no decision on whether airlines will rate anything under them.

CAR Review

Changes seen likely in landing distance, spoiler requirements.

A change in landing distance requirements for transport aircraft and permission for removal of "spoilers" from wings are likely to result from the annual Civil Air Regulations review this month. Taking part in the review are representatives of the airlines, manufacturers, Civil Aeronautics Board, Civil Aeronautics Administration, and of the pilots.

▶ **Changing the Pitch**—Air Line Pilots Assn. representatives got the wheels rolling fast toward revised landing distance regulations by reading a list of 27 accidents killing 58 persons the past six years in accidents that reversible propellers could have prevented. ALPA got immediate industry and government agreement to set up a joint conference "to recommend immediately effective rational landing distance regulations."

Instead of recommending reversible props for all existing transports, as ALPA did in past years, the pilots said: "What is needed is not a flat requirement of reverse pitch propellers, but rather a change in the landing distance regulation."

The pilots say a new regulation would focus on the overall problem of control without brakes and would prepare for jet plane era, when no props would be available. They claim: "Recent CAA tests have shown that the present landing distance requirements are not representative of actual airline operation." (Planes come in faster than the ideal landing speed because of ice, turbulence, cross-wind control, poor visibility.)

ALPA stated: "It is highly significant that, in the six years covered by our study, with the lone exception of the accident of Sept. 4, 1950 (NWA 2-0-2 aborted takeoff), no airplane equipped with reverse pitch propellers has been involved in an overshoot accident, and in the case of the single exception it is a fact that the use of reverse pitch prevented a far more serious accident."

The pilots want a regulation that assures the pilot a positive way to stop his plane on the runway when his brakes are ineffective due to wet or icy runways or mechanical failure of the brakes.

▶ **Spoilers Away**—Manufacturers, airlines and pilots were agreed that stall requirements of the Civil Air Regulations should be rewritten for modern aircraft standards. Chief contention is that strict interpretation of the present regulation forces installation of performance-curtailing "spoilers" on modern planes like the Stratocruiser, Martin 2-0-2, DC-6B and others. The spoilers cure is worse than the disease it's meant to cure, the industry says.

CAA indicated agreement in principle that the stall requirement might need revision, but would not commit itself on the spoiler problem.

The annual CAR review is held to get ideas and to reach some agreement on new regulations wherever possible. But mainly it is an informal review by key engineers and other experts in the transport industry, rather than a law-making conference.

▶ **Other Subjects**—Here are some other subjects discussed at the airworthiness review this month:

• **Freight plane weight.** Pilots opposed a suggestion that air freighters be permitted to fly with 5% heavier gross load than passenger planes. Pilots said progress in air freight economy must come from new plane- and cargo-handling developments, not from overloading an old plane and compromising safety.

• **Cockpit standardization.** All parties agreed cockpits of planes should be standardized. They decided to await the recommendations from the SAE Cockpit Standardization Committee. This committee is made up of the nation's leading test, airline, and military pilots.

• **Temperature-humidity.** Proposed CAR Reg. 4B 117 would require from one-half to one-third accountability for temperature-humidity conditions in determining safe runway and load limits on hot and humid days. At 100F. and 80% humidity, an engine gets only about 85% of its power rating for dry air standard temperature.

• **Power deterioration.** Engines that are not checked constantly often lose power. Airline pilots say the BMEP gauge is the best way to spot power deterioration. Pan American, TWA and some others rely on the BMEP reading. But some domestic airlines complain that the BMEP gauge isn't reliable without too-heavy maintenance on it, and ask pilots to rely on the old manifold pressure gauge. Pilots want a CAR requiring use of the BMEP cauge by all airlines.

Nonskeds Boost 'Operation Homelift'

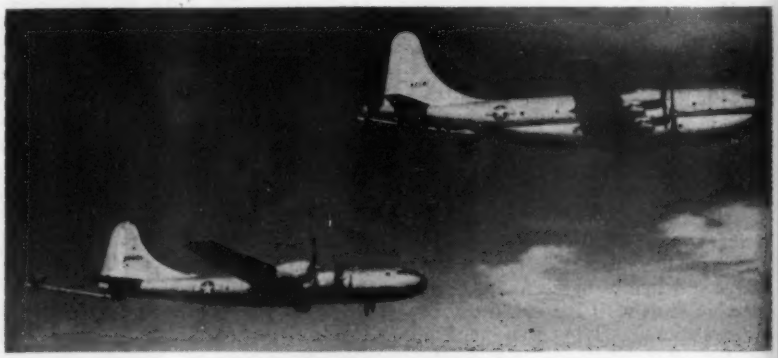
Nonscheduled airlines have increased their 18-plane "operation homelift," lifting Korea veterans from the West Coast to their homes, to twice-weekly departures instead of one.

Some 90,000 veterans are scheduled to arrive on the West Coast August-October for leave before stateside assignment.

On a typical day this month, 18 nonsked planes at Oakland Airport picked up 1,000 of the 4,321 returning veterans who debarked at San Francisco. Destinations included New York, Washington, Boston, Chicago, Cleveland, Dallas, Miami.

These military personnel charters, plus official military travel contracts, may more than double nonsked business volume of a year ago. In the first quarter of this year, without military traffic, their business was double a year ago. An Air Coach Transport Assn. summary of CAB traffic figures shows 35 nonsked airlines flew 126,711,501 revenue passenger miles in the first quarter, compared with only 61,010,283 revenue passenger miles flown by 45 carriers a year ago.

Great Lakes Airlines, with 12,643,293 revenue passenger miles, had the biggest first quarter of the group.



TANKER TEAM

Both types of USAF's current aerial tanker planes, the Boeing KC-97 (upper right) and the KB-29P (lower left) are seen together for the first time, highlighting the different installations of the Boeing-developed Flying Boom on the two types. More than 750,000 gal. of aircraft fuel have been pumped through the booms in more than 8,000 contacts made by the tankers since the first KB-29P tanker started coming off the production lines ten months ago. Many of the contacts, however, have been "dry runs" made during training flights.

Battle Looms on C-46 Load Limits

Plane can be operated safely at 48,000-lb. gross, say operators, who will fight CAB's 43,500-lb. limit.

Nonscheduled and scheduled airlines owning Curtiss C-46 transports are combining to demand a full Civil Aeronautics Board hearing of their opposition to the Board's proposal to cut the plane's allowable gross passenger load.

Already, Flying Tiger President Robert Prescott and nonsked airline presidents Amos Heacock and John Belding have formed a Council for C-46 Engineering.

The operators' council won quick approval from Deputy CAA Administrator Fred Lee to set up a joint operator-government committee to work on the C-46 problem. CAA encouraged immediate investigation of proposals made at the first meeting to be held by the C-46 operator group. Chief proposals by the operators are: water injection to increase the C-46's R-2800 engines' takeoff horsepower about 400 hp. each; shortening the Hamilton Standard propellers for better climb and takeoff performance; installation of dump valves to jettison fuel; a Slick plan to try R-3350 engines on a C-46; and the Council for C-46 Engineering's plan to work out a standard operating and maintenance C-46 manual.

CAB wants to cut down the passenger load. That affects only the nonskeds; they're the ones who use the C-46 for passengers. CAB would cut their load 4,500 lb. or 20-25 passengers, close to a 50% cut in payload.

The certificated cargo carriers, like Pan American, Slick and Flying Tiger, are up in arms about the cut, too. Their pilots may logically argue that if present allowable gross load of 48,000 lb. is unsafe for passengers it is unsafe for pilots.

▶**No. 1 Plane**—The C-46 is the No. 1 plane of the nonsked passenger airline industry and of the certificated all-cargo carriers. The nonskeds in this country operate about 83 C-46s now, mostly seating 50 passengers each. Certificated carriers operate about 61 cargo C-46s.

CAB proposes to write a special Civil Air Regulation reducing the maximum allowable gross load of the plane from the present 48,000 lb. to 43,500 lb. by Oct. 1, 1952; interim stepdown would be to 45,800 lb. by this October (AVIATION WEEK July 23, p. 7).

The new C-46 Council for C-46 Engineering is first of all preparing a defense of the present 48,000-lb. gross weight limitation on the C-46. But it is also working up a coordinated plan to improve the C-46 by technical changes and technical liaison, similar to that provided by the Air Transport Assn. for its members on DC-6s, Connies, DC-4s, Convairs, Martins and DC-3s.

The C-46 owners have an ace in the hole contesting the CAB evaluation of the C-46 ability to meet safety requirements with 48,000-lb. gross weight. That is the engineering data compiled by Pan American at Miami in 1949 after a year of testing. PanAm's tests showed the plane met CAA single-engine performance requirements with gross load up to 48,300-lb.

By taking off 4½ in. from each propeller blade and increasing pitch about one degree, C-46 climb performance can be improved. PanAm has just completed this modification. It is said to increase climb by 10-15%. It is especially good on full low pitch, where the original-length blade tips were so flat and highspeed they were inefficient, with tip speed around Mach 1.

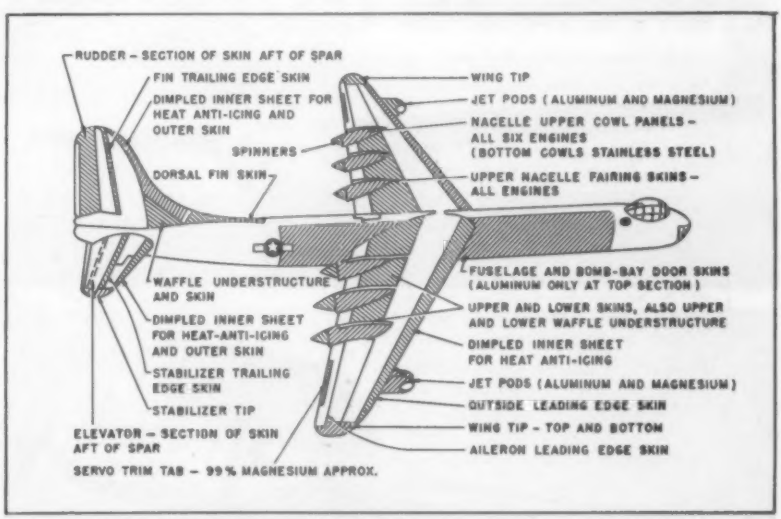
▶**CAB Contention**—Main argument CAB put forth in its draft release proposing reduction of gross load is: "The accident record of the C-46 in civil operations disclosed a relatively high accident rate." CAB goes on to say: "Tests showed that the performance obtained from the C-46 at currently authorized weights is substantially lower than that which would be attained if the transport category performance requirements were applied in full. In particular at 48,000 pounds, the takeoff performance is insufficient for the airplane to continue flight if one of the engines should fail during the critical phase of the takeoff, and in addition, the airplane at such weight, will not meet the single engine en route performance requirements of Part 3."

The CAB release then says that the CAA tests show the plane will meet the en route requirement at 45,800-lb. weight and meet takeoff only under 40,000 lb.

About the PanAm tests which showed the plane capable of safe operation, CAB says the data "was based upon tests conducted under exceptionally favorable conditions."

CAA safety engineers went down to Miami and conducted their own tests on PanAm C-46s this winter, and came up with the now-proposed revision.

▶**Causes**—One reason CAB says it wants to cut the allowable gross load on the Curtiss C-46 is the apparently insoluble riddle of why a Flying Tiger C-46F crashed after takeoff from Stapleton Field, Denver, July 30, 1950. CAB investigators found no defects in the plane. In an accident investigation report recently issued, CAB said probable cause of the crash was "the subnormal takeoff performance of the air-


RUDDER – SECTION OF SKIN AFT OF SPAR
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DORSAL FIN SKIN
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HOW MAGNESIUM LIGHTENS CONVAIR'S B-36

Magnesium plays a vital weight-saving role in Convair's huge B-36. This sketch shows some of the major applications of the metal. Convair builds into the craft about 10,000 lb. of magnesium parts, approximately 75 percent being in the sheet metal category. Government-furnished equipment adds another sizeable amount of the metal, bring its total weight in the plane to about 19,000 lb. In addition to the applications indicated, magnesium is used in the wing catwalk, 85-ft. pressurized fuselage tunnel, air ducts, waffle grid stiffeners, wheels, landing gear doors, brakes, gun turrets, radar, radio, fire control equipment, and engine applications. The sketch recently appeared in The Magazine of Magnesium published by Brooks & Perkins Inc.

craft, the reason for which cannot be determined."

Pilots say the two R-2800 engines operated normally at 45 inches of mercury and 2700 rpm. on takeoff from the 6,980-ft. runway with two-mph. wind. Yet air speed increased slowly. At speed between 90 and 100 mph., and just before reaching runway's end, pilot pulled the plane up with back pressure on the control column. After takeoff the highest speed he got was 100-105 mph. He climbed to 100 feet, with the plane shuddering severely. Then the plane began to sink. It struck an obstruction light on top of a 40-ft. electric light pole 1,910 ft. south of runway's end. Plane hit three more poles as it settled in. Plane was washed out, but no one was hurt.

►**Findings**—CAB finds that under existing weight, wind and pressure conditions, the plane should have reached 50 ft. and air speed of 123 mph. 5,850 ft. from takeoff start; this particular plane was reported consistently slower in acceleration and takeoff than others of the same type; the pilot used a 6,980-ft. runway under virtually no-wind conditions when he could have picked an 8,500-ft. one; take-off was in tail-low attitude at almost the very end of the runway; in a climb of 100 ft. a partial stall developed.

Three weeks after the C-46 accident, another C-46 flight experienced similar trouble taking off from the same runway, but got back safely.

In the report, the Board concludes: "As a result of this (C-46 crash) and other experiences with the C-46 which indicated certain deficiencies in the takeoff performance of this model aircraft, the (CAA and CAB) undertook a general study of this problem. . . . CAA conducted a series of tests. . . . The Board has proposed by appropriate amendment of the Civil Air Regulations to adjust downward maximum take-off weights. . . ."

Carrier Clears Deck With Hinged Stacks

The biggest aircraft carrier yet, the Navy's new James V. Forrestal, will go back to the old-time carrier Ranger for the principle of folding stacks to give a greater, clear deck area. Plans for the new Forrestal call for its stacks to be hinged and fold outward as they did on the old Ranger.

This feature, combined with the retractable island of the super flattop will give a clear area 1,040 ft. long and 252 ft. wide. (This compares with an overall length of 968 ft. and a beam of 136 ft. for the Midway class CVB carriers, largest now in service.)

Navy's contract for the Forrestal with the Newport News Shipbuilding & Drydock Co., at Newport News, Va., is expected to run to about $218 million. The carrier is to be completed some 36 months after construction starts.

Standard displacement of the new carrier is 59,900 tons as compared to 45,000 tons for the Midway class. Displacement with full load is expected to top 70,000 tons as compared to approximately 60,000 tons for the Midway class.

►**Air Over Ships**—Announcement of the retractable-island principle indicates that the Naval aviators had their way in an argument with the Navy Bureau of Ships over whether the island should be retractable or not.

A Navy spokesman has denied reports that a second similar carrier has already been approved by the Joint Chiefs of Staff. However, high Navy airmen are convinced that additional big carriers will soon follow.

Australian Canberra Bomber 'Years Off'

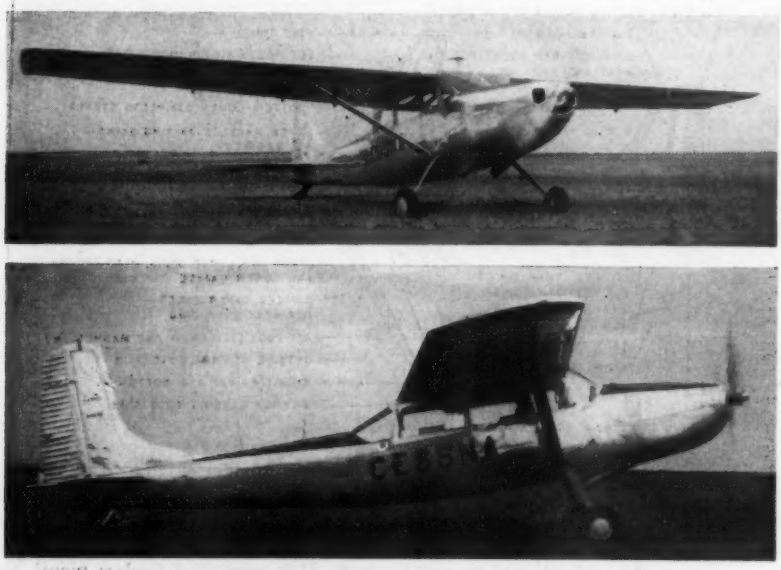
(*McGraw-Hill World News*)

Melbourne—Although tooling for Australian production of the Canberra jet bomber was supposed to have started more than a year ago, no responsible officer of the Government Aircraft Factory at Fishermen's Bend will yet put an estimated date on completion of the first bomber. At present they will not commit themselves further than that it is "years off," according to one of the leading Australian aviation magazines.

Like other defense production executives in Australia, the GAF men could use as their motto, "Give us the tools and we will do the job," the magazine comments, adding that the first tool Australia needs is a real feeling of defense urgency.

But there are physical tool shortages, too. Machine tools, jigs and materials are not rolling in from North America and Britain as speedily as they are required. As a case in point, GAF is not expecting delivery of badly needed American stretching presses for at least 18 months though orders were placed some time ago. And there are no extrusion presses in Australia capable of making the Canberra's spar booms. These spar booms will have to be imported until extrusion presses can be obtained. Delays are also expected in the delivery of production jigs from Britain.

There is an acute shortage of skilled production workers. Pressure on the tool-making and sheet-metal working staff is expected to be eased somewhat by adoption of the Robinson lithographic process in lofting. By this method the lofters make the working drawings with perfect accuracy on a master metal sheet. From this, copies are reproduced on working sheets by lithographic methods. The sheet-metal workers merely follow the engraved lines instead of working from blueprints.



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Model 308 is a bigger and more powerful ambulance, light cargo or reconnaissance monoplane built by Cessna for trials by the Army Field Forces, Air Force and Marines. Powered by a 375-hp. Lycoming and turning a Hamilton Standard prop, the 308 can carry a payload of over 1,000 lb. more than 800 mi. The plane retains Cessna's wide tread safety spring steel landing gear. Initial testing program is now underway at Wichita.

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Experts Tell Why Planes Cost So Much

Kindelberger explains the difference in cost between P-51 and F-86.

Congress is trying to find out what makes a fighting airplane so expensive.

What is behind the $600,000-plus cost of an all-weather craft like North American's F-86D?

Why does it cost so much more now to produce planes than it did in World War II?

Where is the greatest increase in cost –engineering, labor, materials?

The aviation industry has been on the receiving and sending ends of such questions ever since the current aircraft production boom began. The industry is interested in getting the answers to those stumpers. So is the taxpayer; so is Congress.

A subcommittee of the House Appropriations Committee invited J. H. Kindelberger, chairman of the board of North American Aviation, Inc. and J. L. Atwood, NAA president, to give some of the answers as North American saw them.

▶**Comparative Data** – Kindelberger stated that he thought the best approach was to draw a series of comparative figures between North American's WW II Mustang (F-51) and the postwar Sabre (F-86).

After an off-the-record comparison, which undoubtedly included performance data for the two planes, he presented material on some of NAA's machinery and test facilities. As examples, he said that a skin mill–for machining the thick outer skin of the F-86–will cost about $150,000. Essentially, a skin mill is a planer bed with a milling head above it; a lot of the cost represented is electronic control equipment.

A Drivmatic riveter will punch holes, put the rivet in and head it over, said Kindelberger, and to do that job, you pay $25,000 per machine.

More expensive is the Hufford stretcher which forms fuselage skins, duct sections and the like. These run up to $250,000 each. And topping the list are hydraulic presses, representing as much as $500,000 apiece.

All these types of machines are necessary, stated Kindelberger. North American didn't use them during the second World War, except on a small scale.

After showing charts of some of the company's research and development facilities, Kindelberger started presenting the meat of the testimony.

▶**Power, Speed, Altitude**–First reference was a weight comparison of the F-51 and F-86. Ready for combat, the Mustang grossed 9,430 lb.; the Sabre weighs about 1½ times as much, or 13,885 lb.

Comparing thrust horsepower, the Mustang had a maximum altitude thrust horsepower of 1,461. This was to be compared with the value of 10,400 for the Sabre.

And on speed, the Mustang figure was given as 440 mph; the Sabre was credited with its official record of about 671 mph.

For altitude, the Mustang reached 36,491 ft.; the Sabre, 50,000 ft.

"You can see", said Kindelberger, "how you are starting to build up complications and expense as you build up speed and altitude. That is what you are paying for."

Then to show the Congressmen just how cost figures were broken down for modern airplanes, and how the figures compared to values for the Mustang, Kindelberger showed a chart of time and money expended for the Mustang and the Sabre in low- and high-volume production. And at a somewhat later point in the proceedings, he introduced a second chart which gave values for the all-weather version of the Sabre, the F-86D. (The data from these charts are

Table I

Cost Comparison

(Based on first 620 airframes)

	P-51 MUSTANG (actual)	F-86 SABRE (actual)	F-86D (ALL-WEATHER) (estimated)
Airframe weight, lb.	4,268	6,801	8,137
Engineering hr.	414	3,368	3,230
Cost per hr.	$1.68	$4.20	$6.04
Engineering cost	$6.98	$14,146	$19,529
Tooling hr.	877	3,587	4,190
Cost per hr.	$2.33	$4.06	$5.59
Tooling cost	$2,044	$14,576	$23,425
Factory labor, hr.	7,375	17,838	22,713
Labor rate	$.873	$1.50	$1.80
Factory labor cost	$6,441	$26,831	$40,883
Burden rate, %	90	122	135
Burden	$5,823	$32,760	$55,192
Material	$11,735	$32,819	$40,280
Total airframe cost, less general and administrative and profit	$26,741	$121,132	$179,309

Table II

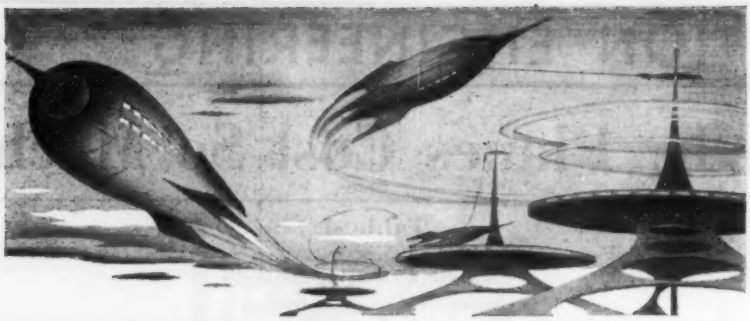
Engineering Man-Hours to First Flight

	P-51	F-86D	NET INCREASE
Aerodynamics	600	72,520	120 times
Windtunnel	2,077	42,006	21 times
Stress	2,985	116,075	38 times
Detail design	34,963	640,381	18 times
Flight test	725	84,817	120 times
Research	None	66,512	.....
Miscellaneous	530	109,681	200 times
TOTAL HOURS	41,880	1,131,992	27 times
Number of drawings	1,100	6,572	6 times

Table III

Engineering personnel required to complete initial design

	P-51 1940	F-86D 1951
Aerodynamics	3	34
Thermodynamics	0	12
Windtunnel	5	38
Vibration and flutter	0	4
Stress analysis	10	48
Flight test	4	136
Research	0	32
Drafting	69	255
Other	3	47
Total	97	606



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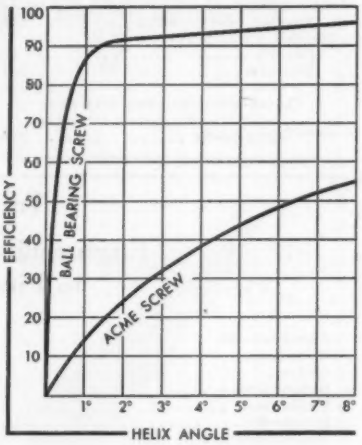

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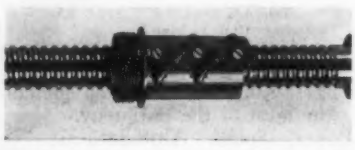
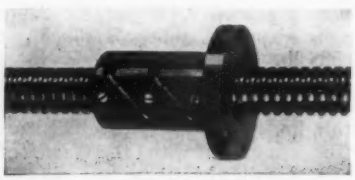


Threaded-type nut. Two-circuit assembly.



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combined in Table I.)

Some explanation of the items in the chart was necessary. It was explained that airframe weight referred to the weight of the airplane not including the engine and the Government-furnished property. This latter item was considered to include the engine, certain instruments, some of the electronic gear, wheels and tires. Incidentally, armament—the only excuse for building a fighter—was omitted from the list of GFP, although it belongs there.

Burden rate is, of course, the overhead; this includes the cost of heat, light, power supervision, expendable tools and parts, soap, towels and such.

► **Individual Output**—When questioned about individual output, Kindelberger stated that he did not believe there was much difference between the way people work now and the way they worked then. It was a case of keeping the work in front of a man at the right flow rate and at the right time.

In explaining the increase in engineering time, Kindelberger said that it was largely due to the fact that ordinary run-of-the-mine draftsmen couldn't be used. Highly trained scientists and engineers had to do this new type of work.

And he added that the engineering cost figures included engineering overhead as well. In this case, it was about 89%, which would cover blueprint paper, housekeeping and travel, among other things.

To point up the amount of drawings needed to produce the F-86, it was stated that every month, the blueprint output could cover the factory production floor area of 2,500,000 sq. ft.

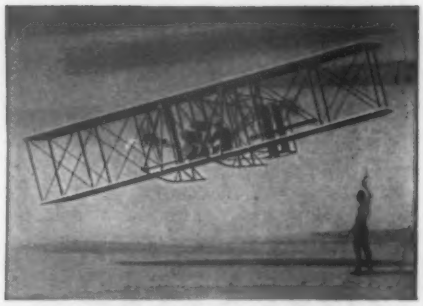
Referring to the F-86D, Kindelberger pointed out that the final airframe cost of $179,309 did not include GFP and about $77,500 which represented the cost of radar, rocket fire control and navigational equipment being furnished.

Lt. Gen. Edwin W. Rawlings, Air Force comptroller, who was sitting in on the session, was asked to help reconcile NAA's figures with a cost of $900,000 for an all-weather plane. (Apparently such a cost figure had been submitted in a budget request.)

Rawlings supplied a fly-away cost for an unspecified quantity of the F-86D aircraft of $344,824. This, he stated, was for an operating airplane ready to fight. But program cost, which would include spare parts and special ground handling equipment, was given as $624,682 (presumably per airplane, and also for an unspecified quantity).

► **Engineering Increase**—Two more charts showed the increasing complexity of the engineering operation for a modern fighter plane (Tables II and III). The most interesting thing about these charts is the almost unbelievable increase—as much as 200 times—in engi-

FIRST



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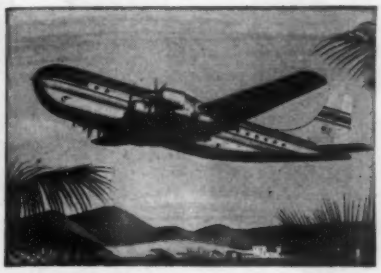

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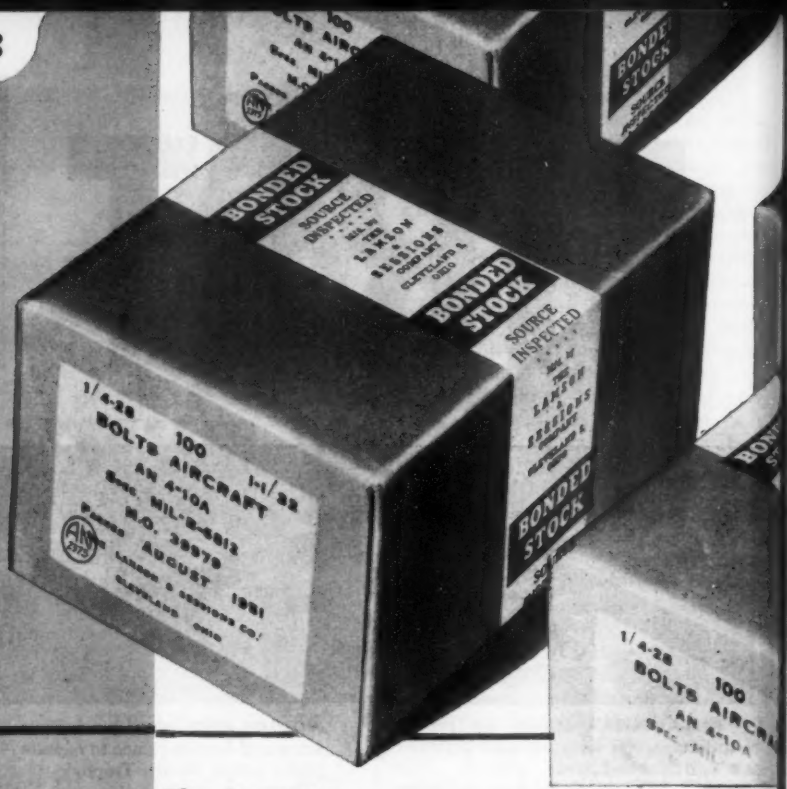

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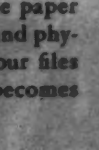

3 Fasteners in bulk, when declared surplus, have, in the past, been found to have little more than scrap value.

The Lamson SOURCE INSPECTED-BONDED STOCK Way

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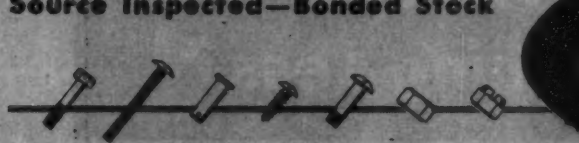

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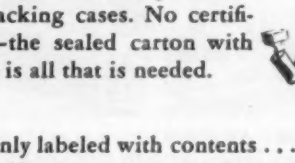

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neering man-hours. And not only is more actual time involved, but the time itself is more expensive because of the increased quality of the engineers employed.

Factory direct labor costs had a chart of their own, which showed their increase from an average value of $0.75 per hour in 1940 to a current figure of $1.75, "with more in the offing."

While on the subject, the matter of fringe benefits and their cost was discussed. Kindelberger wanted it understood that he thought fringe benefits were wonderful, but that they had to be counted as elements of cost. "In 1940 we did not have any holidays. We did not have vacation and we did not have any sick leave or rest periods."

But now, said Kindelberger, NAA has 10-min. rest periods, morning and afternoon. These are really 15-min. periods, because the power load curves on machines show average times of 2½ min. at either end of the rest periods for getting ready to rest and for getting over resting. This is half an hour per day.

On the basis of working 240 days per year, the brief rest periods represent three 40-hr. weeks. Added to this are six paid holidays, two weeks' vacation and one week sick leave. The total: seven weeks plus one day for which people are paid and for which they do not work in return.

"I cannot say they are bad; I just say that they are expensive."

▶**Subcontracting**—One chart which did not get inserted into the record of the committee hearings had to do with subcontracting. And it is too bad that it was not recorded, because it apparently showed that subcontracting by NAA is efficient from every angle except cost. Kindelberger said that it costs NAA 220 hr. per unit over what it would cost to do it at North American's plant.

Another chart covered the factory overhead burden. It showed that, among other increases, planning and production control had doubled. Why? "We are now handling 250,000 shop orders in the plant with spares and everything else, and we are having much better control, which results in lower labor costs. In other words, suitable control increases the burden but reduces the total cost."

Atwood was asked if there were any way in which airplanes could be produced at less cost. "Would there be some way of making a management study of your labor utilization and eliminate thousands of workers and yet get the same production? . . . Is there an area for saving there?"

"If you were sitting on this side of the table as a Member of Congress, representing the impatient taxpayer who complains that costs are too high and that waste is prevalent, what would you do in regard to the high cost of aircraft?"

▶**Quotable Answer**—Atwood's answer deserves quoting. He said, "Most production . . . is for a special purpose. You make a uniform. There is no sense in raising the quality after you reach a certain point. It would be uneconomical and foolish. . .

"However, in airplanes, we have no limit to the quality objective from a performance point of view. We do not know what the boys are going to have to compete with when they go into battle, and we are very apprehensive at all times they will come up against superior enemy aircraft. . .

"Now, improvement in quality means continuous innovations. That means experiment and experiment means cut and try. It means rejection of ideas as well as acceptance and incorporation of these new ideas. That involves laboratory work, calculations and developments of all kinds. It means further as soon as something works better, it should be incorporated, and we do not wait.

"If we wait, we are asking for trouble . . . when these planes go into competition, and consequently we cannot stop at any point."

▶**Lowest Figures**—Kindelberger was

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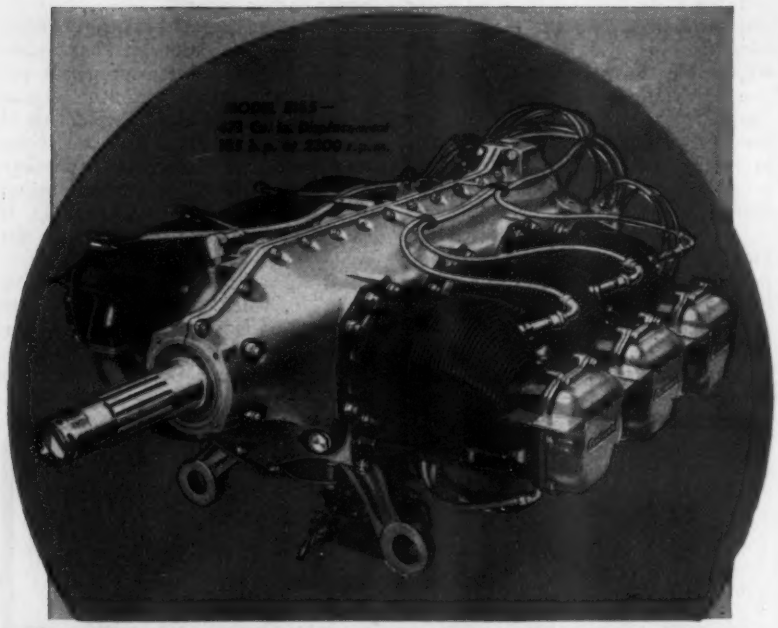

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asked if the estimated unit costs would be the minimum costs foreseen, or would it be possible to reduce them further as production increased.

He answered that it was the best possible estimate that could be made. He wanted it known that achieving lower costs is NAA's primary function in life (presumably aside from building airplanes) and that the methods development group, staffed by industrial engineers, was charged with the responsibility of producing cheaper methods to do things.

Also, he added, though the aviation industry is highly competitive and "cut-throat", there is a surprisingly large interchange of information on how to do things cheaper.

After more questioning, Kindelberger was asked if he felt the aircraft industry was capable of taking on the multi-billion sum for procurement of aircraft. He was reminded that NAA had $700 million worth of undelivered orders and was asked what about that.

By referring to lead times—the delay between order-placing and delivery—Kindelberger explained that the money would actually stretch over about a three-year period.

Then the next question was a rewording of the one about backlogs; Kindelberger was asked if NAA and other aircraft companies would be able to produce the planes currently contemplated in the 1952 program.

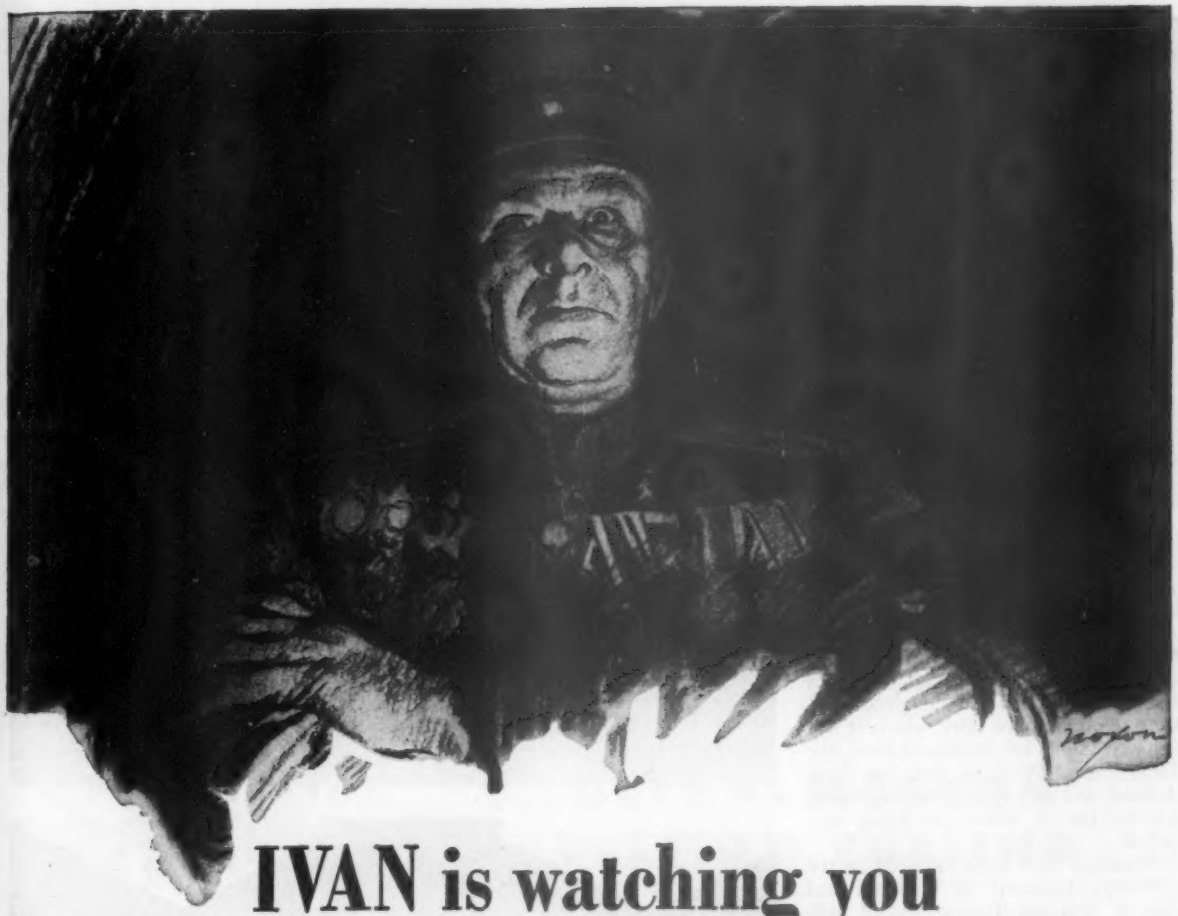
His answer was that he saw no real difficulty with airframe production. But ". . . we are going to have great trouble with the electronic equipment, and with all this fire-control equipment . . . and the gadget auxiliary stuff such as cooling turbines. . . The engines are still slow, and so are all of these items. . . . The engines and all of the gadgetry are all in a constant state of flux and improvement. Many of those things . . . will not be finished until tomorrow because it is awful hard to put a time caliper on thinking and invention."

Jet Fuel Carbon Probed in Tiny Cell

A tiny combustion chamber, developed to investigate the carbon-depositing tendencies of jet fuels, is being used at the Wright Air Development Center, Dayton.

The combustion chamber, a scaled-down version of a typical combustor for a jet engine, is a burner liner about 2 in. diameter. It is fed by a preheated jet of air at 400F (which is the air temperature as it enters a typical jet engine combustion chamber).

Although the primary use to be made of the test apparatus will be the carbon-deposit investigation, the unit will also be used to test combustion efficiency.



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THE BETTER WE PRODUCE
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Two New Aircraft for French Navy

Lack of patrol, strike planes may be eased by Breguet types.

Two new naval aircraft are in the offing for the French if the current plans of the Louis Breguet company reach fruition.

The French government for some time has been worried by the lack of reconnaissance and strike aircraft attached to the fleet; L'Aeronautique Navale still uses prewar Short Sunderland flying boats and Curtiss Helldivers. There is nothing in the Lockheed Neptune or the Douglas Skyraider categories.

But Breguet, with a conversion of its 761 "Deux Ponts" transport and an entirely new turboprop-plus-turbojet two-seater, the Type 96 Vultur, hopes to furnish the French naval air service with a shot in the arm.

▶**Deux Ponts**—The French rearmament plan of 1950 allotted funds for the production of 15 four-engined maritime reconnaissance craft, which it was believed could be developed from the Deux Ponts. Work on these has been delayed, and only now is the first flying test-bed for the new series being converted.

Mockups have been installed in the prototype transport at Breguet's test site at Toulouse-Blagnac. Only military equipment has been mocked-up, including a two-gun dorsal turret, two-gun tail turret, a retractable belly radome, bomb bays and wing tip tank tanks.

All guns are 20mm.; the tail turret is remotely controlled. The dorsal turret is just aft of the cockpit. Bomb bay is divided into two sections, with the radome mounted between.

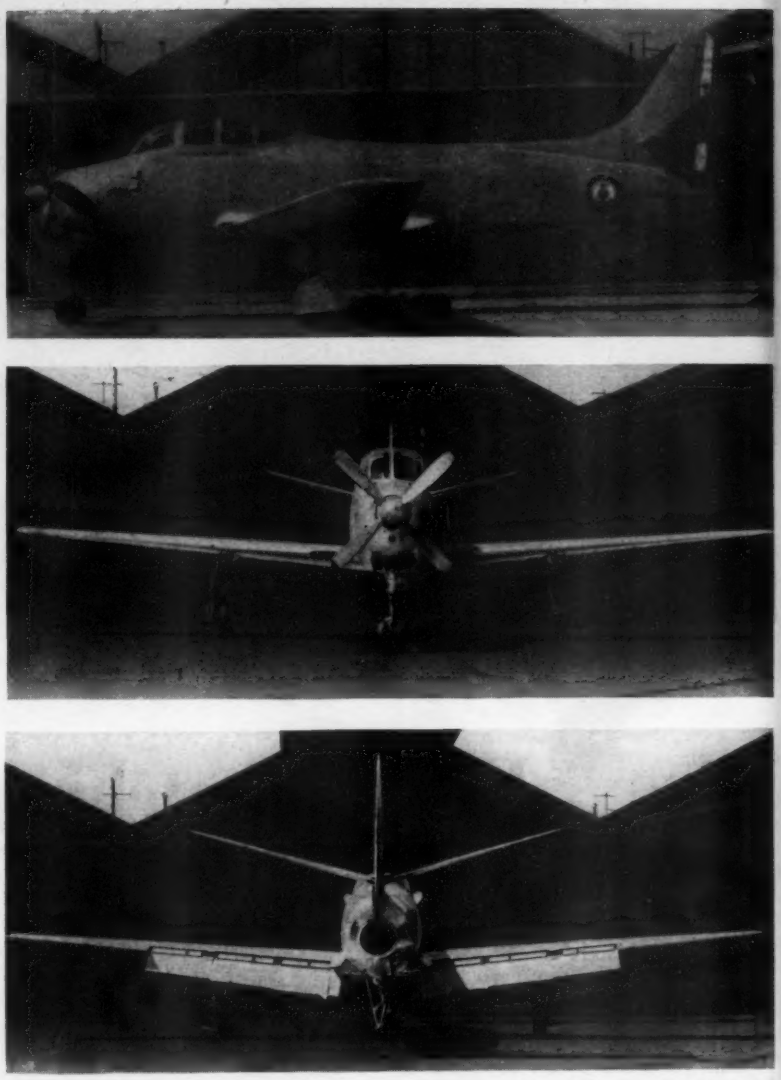
French-built engines have been removed and may be replaced by Pratt & Whitney R-2800-CA-18 engines rated at 2,400 hp. each. These engines power the civil production Deux Ponts transports for Air France.

The civil plane's dimensions: span 141 ft., 1 in.; length 97 ft. 3 in.; height 31 ft.; weight empty 55,903 lb. Its cruising speed: 230 mph.

The military type is designated Br. 764; the definite order for a production lot has not been given, pending the outcome of flight trials with the new patrol plane.

▶**Type 96 Vultur**—The second naval craft under development at Breguet is the Vultur, a strike aircraft powered by an Armstrong Siddeley Mamba in the nose, and a Hispano-Suiza Nene in the tail.

The Mamba gets its air from an annular intake with exhaust under the



BREGUET VULTUR, naval strike aircraft, is powered by turboprop and turbojet.

port wing; the Nene is fed from wing root leading edge inlets.

The wing has a Breguet laminar-flow section and is thick-skinned. It has considerable taper on leading edge, and carries large slotted flaps and dive brakes.

Main landing gear legs retract inwards into the wings, and the nose leg —which has twin wheels—retracts backwards.

Horizontal tail has considerable dihedral. Just under the jet exhaust, a tail bumper is mounted.

Seating is for two, side-by-side; ejector seats are used.

For work off carriers, the Vultur is expected to cruise on the Mamba alone at speeds between 217 mph. and 248 mph. Its armament will consist of eight rockets plus depth charges or a torpedo, externally slung; long-range auxiliary tanks will be carried at the wingtips.

A second prototype is nearing completion, and it will be powered by the Mamba 3 of increased power. In addition to these Naval versions, there is a land-based close-support version, with a one-man crew. Designation of this type is Br. 961.

Span of the Vultur is 54 ft. 3 in.; overall length is 43 ft. 3 in.; height is 16 ft. 9 in. Empty weight is 15,500 lb.; gross is 22,300 lb.

Max. speed with both engines is 558 mph.; max. cruise, 248 mph.; carrier landing speed, 95 mph. Cruise duration on turboprop alone is 4½ hr.

—Derek H. Wood

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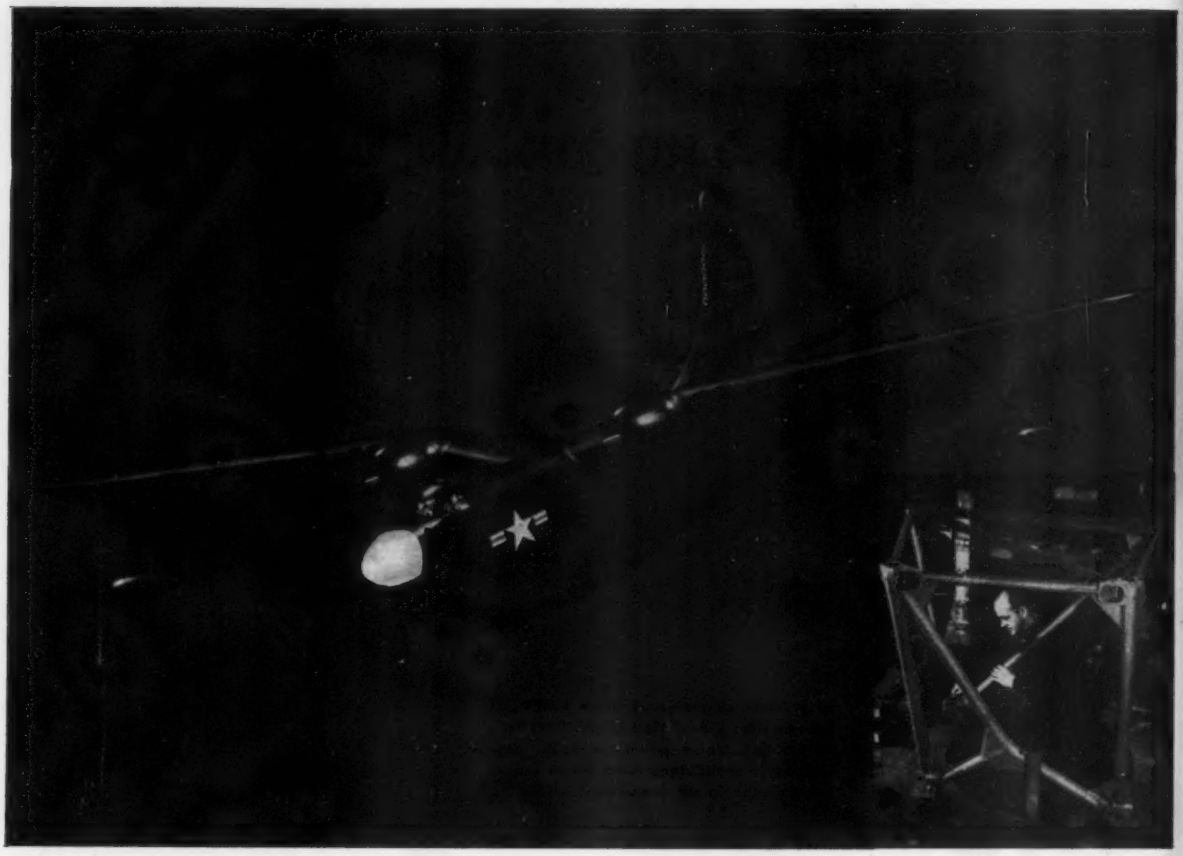

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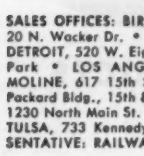

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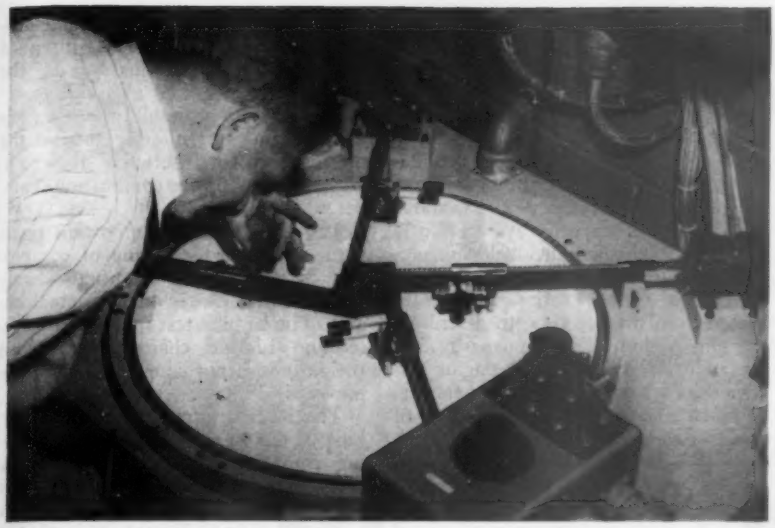

RECORDING TRAVERSER designed by Avro for its wilderness lab at Nobel enables engineers to plot data which is transmitted to electronic computers at Malton.

Wilderness Lab Serves Avro

Jet engine test center is 165 miles from home plant, but communication network makes it efficient.

Faced with the necessity of obtaining results quickly but having limited funds with which to work, A. V. Roe Canada Ltd., has set up a jet engine test plant at Nobel, in the northern Ontario bush, 165 miles northwest of its plant outside Toronto. Here in a converted wartime explosive plant, Avro is doing all experimental and test work on the Orenda jet engine.

Because of the need for speed, Avro engineers have devised much equipment for making various tests on blades, compressors, combustion chambers and other parts of the jet engine. Semi-automatic recording and computing devices, using electronic circuits, have been developed and patented.

▶**Work Speedup**—Avro engineers point out that the work has been speeded up at least five times with the use of automatic recording equipment. Figures obtained from tests are tabulated and sent by fast messenger or teletype to the main factory at Malton, outside Toronto, where electric computers arrive at design figures for the engineers.

With the test specimen at hand, Avro says it is possible to make a complete two-dimensional investigation of the airflow through a cascade in a matter of hours, and a three-dimensional investigation of the flow through a single stage of a compressor or turbine in weeks. Without such devices the cascade investigation would take weeks, while the time and running costs for a single stage investigation would be prohibitive.

STETHOSCOPE is handy to listen to compressor operation when facilities are limited.

This use of electronic test equipment is probably the most notable feature of this wilderness test plant. The 12-acre site is part of a vast explosives preserve, where commercial explosives are still manufactured. The Avro test plant is Canadian government-owned, loaned to Avro, and comprises nine buildings. These include a power house, a standby steam-turbine-generator set, a large tank for high-pressure air, reciprocating compressors, a water pumping station on Georgian Bay three-quarters of a mile from the plant and a maintenance machine shop.

▶**Test to Improve**—The full-scale test

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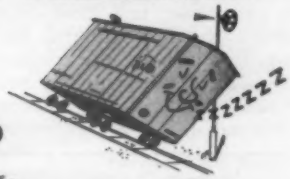

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plant at Nobel is engaged in testing, with a view to improving, the aerodynamic and thermodynamic characteristics of the main components of the Orenda jet engine. At the Malton factory's test department, concentration is upon mechanical improvements of components and fuel system development. Long-term programs are worked out at Nobel to provide design information for future designs of jet engines.

The Nobel test plant now contains several operating test rigs, including a compressor test stand, variable-incidence cascade windtunnel, diffuser test rig, two high-pressure combustion test stands and an atmosphere and altitude combustion test stand. A new turbine test and another compressor test rig are now nearing completion. All test rigs use compressed air, although in the compressor test rig a steam turbine is used to drive the engine compressor under varying conditions to determine its performance characteristics.

The compressor test rig is used to determine such characteristics as flow, pressure and efficiency for various speeds. Instrumentation is sufficiently complete to enable individual stage performance to be determined. Detailed traverses of various sections may be required from time to time to determine the flow pattern of any apparently critical zone. An Avro Chinook engine turbine driven by steam is used in the rig, a much more economical means of power than buying a new turbine.

► **Cascade Tunnel**—The variable-incidence cascade wind tunnel is intended to provide basic information for the design of turbines and compressors.

The function of the diffuser test rig is to determine on full-scale models the pressure recovery between the compressor outlet and the combustion chamber inlet.

The high-pressure combustion rig is designed to permit testing of combustion chambers under conditions closely approximating those on the actual engine. The turbine test rig is used to determine turbine characteristics when the turbine is not coupled to the compressor.

The altitude and atmospheric combustion test rig provides means for testing combustion chambers under low pressure conditions. Development tests at atmospheric pressure have a great advantage over pressure tests in that it is easier to look upstream to observe hot spots and flame conditions. Altitude tests are necessary to predict the chamber performance at altitude, practicularly with reference to blow-out and light-up characteristics.

► **Round-the-Clock**—In view of the large number of programs being followed simultaneously at Nobel and due to electric power restrictions at certain hours, it is necessary to operate on a 24 hour basis. A staff of about 125 men work at the plant, with a small secretarial staff.

The plant and part of the village were built during World War II by the Canadian government and loaned to A. V. Roe Canada Ltd. at a book value of $4 million by the government. Avro executives estimate that between $500,000 and $1 million has been spent on alterations, new equipment and other development work since the company took over the plant in 1946. Within 18 months test work was being done at the plant, whereas it would have taken about five years to build an entire new full-scale jet engine test plant.

Both test plant and Malton plant of A. V. Roe Canada Ltd., are on full military production of the Orenda jet engine and the CF-100 Canuck twin-engine jet fighter powered with the Orenda engine.

CF-100 Subcontracts

Subcontract for considerable portions of its CF-100 Canuck all-weather jet-fighter have been placed by A. V. Roe Canada with Chatco Steel Products Ltd., Tilbury, Ont.

Chatco will make rear and rear center fuselage sections, tailplanes, rudders, fins and tail cones. It is estimated that employment will rise to 800-1,000 workers as a result of the contracts.

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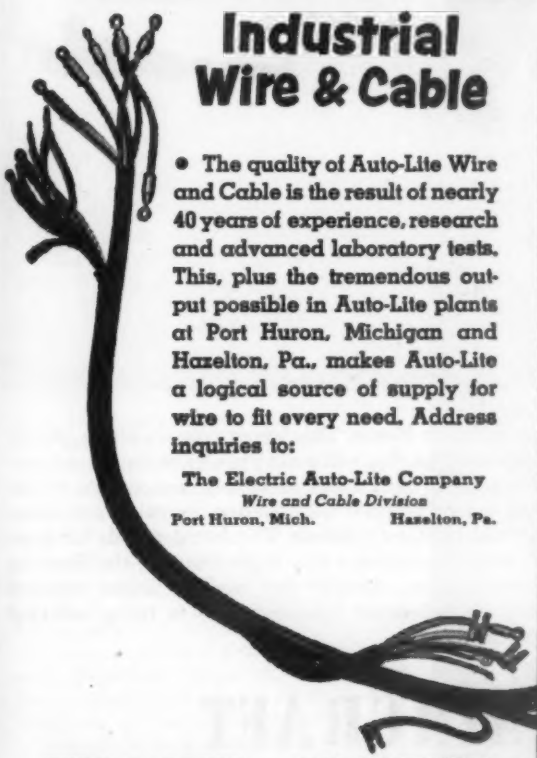

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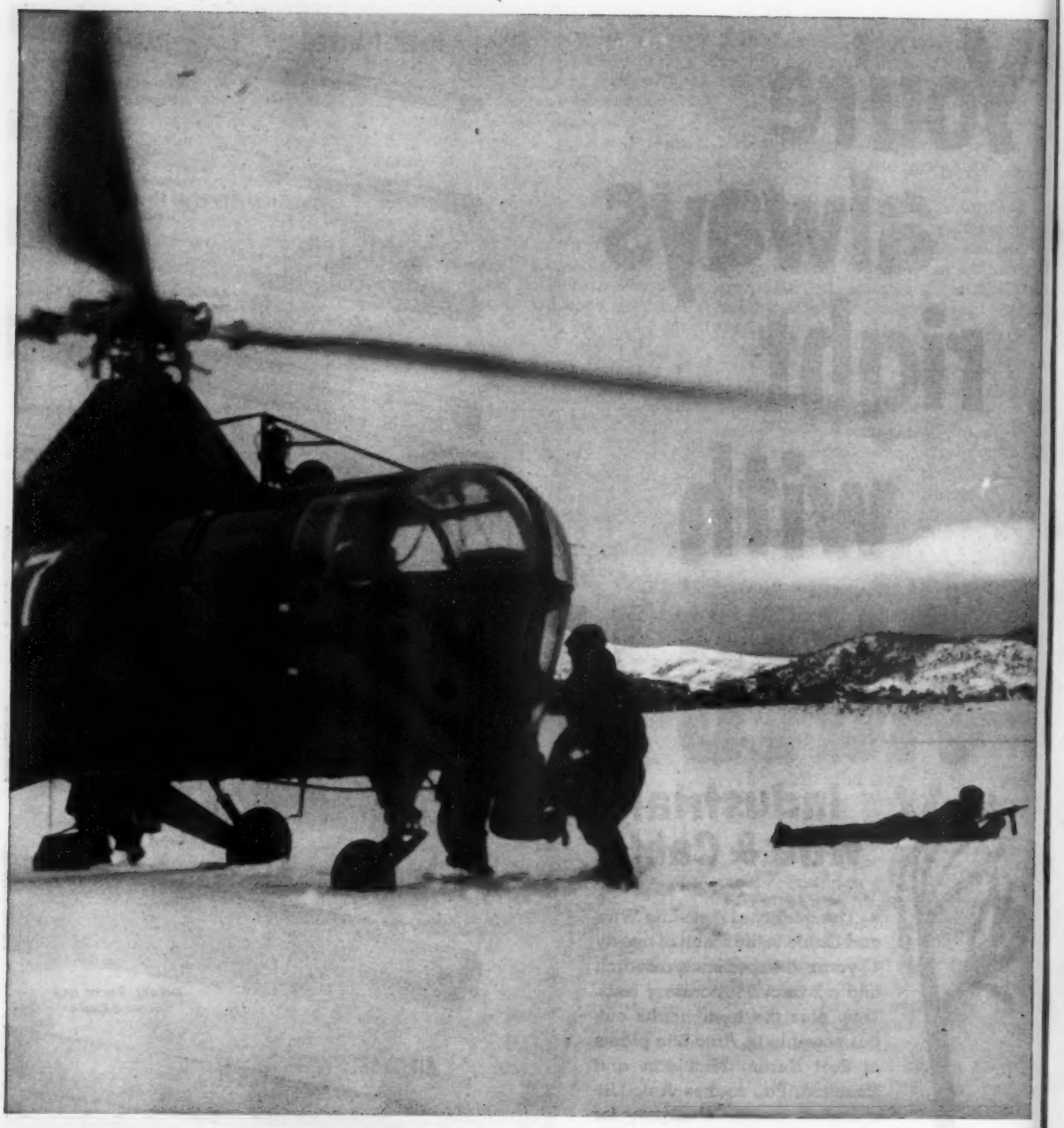

Freedom Ship—Machine gunners keep Communist troops from closing in, as crew members of a beached Allied corvette are rescued from enemy-held shores in Korea by a U. S. Navy Sikorsky helicopter. Flown by all branches of the service, this versatile aircraft has demonstrated conclusively that even under the toughest combat conditions, it can perform vital tasks, virtually impossible by any other means.

Now a bigger 10-place Sikorsky helicopter has gone into action in Korea. This larger type—with its greatly increased capacity, will make even more important contributions to such tasks as supply, evacuation of the wounded or trapped men, liaison, spotting and other essential military missions. To meet demands for more Sikorskys, including a new 4-place model, the Sikorsky Aircraft plant—already the world's largest devoted solely to helicopter manufacture—is being enlarged by a third.

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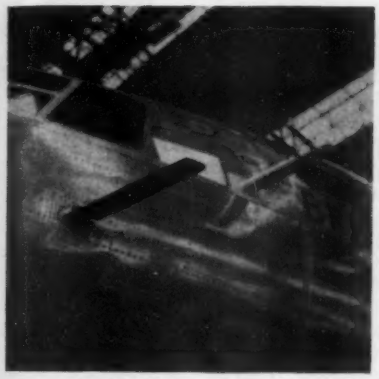


GUST INTENSITY is measured by sensing vane.

Flight Tests Bring Brabazon Changes

Another milestone in the Brabazon project—granting of a new category of Certificate of Airworthiness for carrying non-fare-paying passengers—has just been passed. According to the manufacturer—Bristol Aeroplane Co. Ltd.—this brings the day nearer when it will be possible to operate nonstop as well as through service between London and New York.

There have been significant advances in the design of the big Brab during its flight test program, now near the 300-hour mark.

▶ **Mass Balances**—One indication of progress is the removal of the mass balances from rudder and elevators. These were originally installed to reduce the risk of oscillation or flutter.

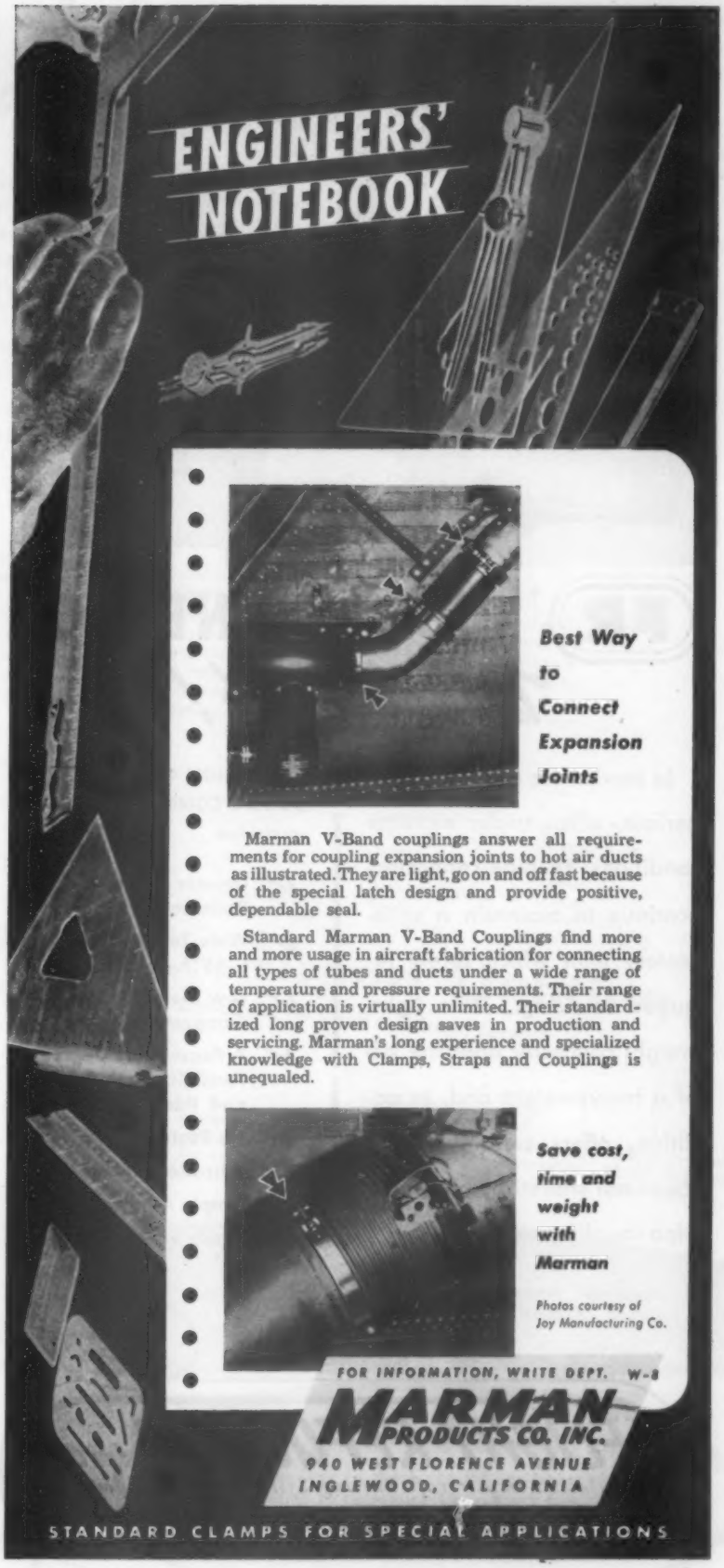
Just recently, removal of the balances was completed, after extensive tests on the aircraft and in special test rigs. As a result, the feel of the airplane is considerably improved—making it easier to fly—and there has been a reduction in drag and consequent improvement in performance.

Furthermore, removal of the balances has meant a weight saving equivalent to three passengers.

Preliminary testing of the pressurizing and air-conditioning systems has begun. Ultimately, the systems will maintain an 8,000-ft. cabin altitude at a flight pressure altitude of 25,000 ft. Incidentally, the length of the Brab will increase by ¾ in. under full pressure.

Initial target figure for the systems is a differential pressure of 4.1 psi., giving an equivalent cabin altitude of 10,000 ft. at 23,000-ft. flight altitude.

▶ **Gust Alleviators**—Substantial progress has been made in the development of gust alleviation equipment. The idea here is that a gust-sensing device is located on the airplane somewhere—on a boom at the nose or the wing. When a gust hits the device, producing an angle of attack change on it, the sensor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Standard Marman V-Band Couplings find more and more usage in aircraft fabrication for connecting all types of tubes and ducts under a wide range of temperature and pressure requirements. Their range of application is virtually unlimited. Their standardized long proven design saves in production and servicing. Marman's long experience and specialized knowledge with Clamps, Straps and Couplings is unequaled.
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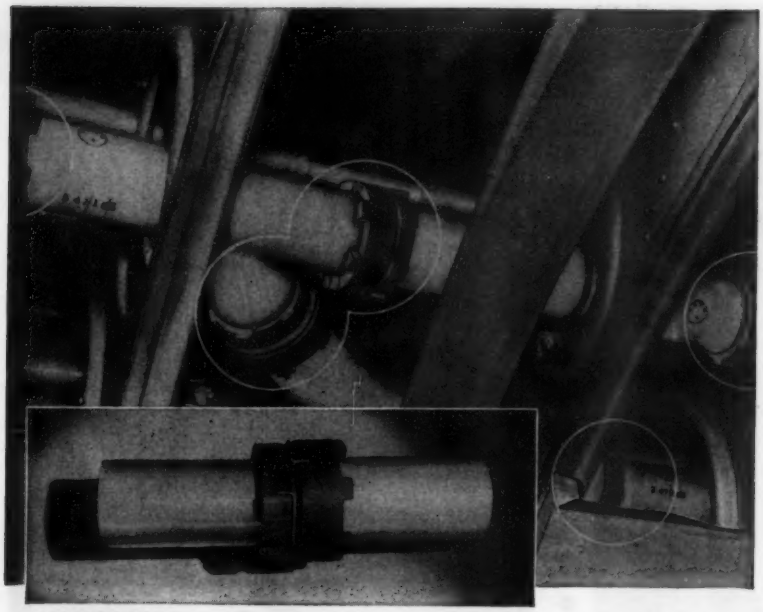

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Does the Job!

In service use over extended periods, often under extreme conditions, FR pipe connectors continue to maintain a satisfactory joint which rarely requires servicing. This lightweight connector does the job of a heavyweight and, in addition, offers certain advantages not shared by any other pipe coupling method.

THE DESIGN OF THE FR PIPE CONNECTOR *provides:*

- ✔ Greater Pressure Resistance
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- ✔ Low Weight and Compactness
- ✔ A Reasonable Degree of Flexibility Both Axially and Radially
- ✔ No Restriction to Flow
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- ✔ Simple Application
- ✔ Ready Serviceability

Additional information will be sent on request. Address inquiries to Dept. AW-51.

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measures the intensity of the gust. Through linkages and servos, controls are repositioned to reduce the effect of the oncoming gust.

On the Brabazon, a detector vane protruded from the fuselage near the pilot's position, which puts the detector about 50 ft. ahead of the wing.

Response measurements are now being made in flight with the detector vane, and the rest of the mechanism is undergoing bench tests.

The true-airspeed boom has been removed from the nose of the Brab to facilitate the installation of a Decca navigator system. Airspeed is now measured by normal pitot heads.

► **Changes for Mk. II**—Bristol has released a descriptive brochure which shows, by three-view drawings, what changes are currently anticipated for the Mk. II version of the Brabazon. This later mark is to be powered by coupled Bristol Proteus turboprops, instead of the current Centaurus 20 reciprocating engines. The large single-wheeled landing gear of the Mk. I will be supplanted by a 4-wheel bogie undercarriage, soon to be fitted to the prototype Mk. I for testing in a series of touch-and-go landings.

The gracefully curved vertical tail of the giant ship is to give way to a straight trailing-edge layout with larger rudder area.

Flap layout is altered somewhat to allow the Proteus tailpipes to discharge at the trailing edge of the wing. The tapered-chord ailerons of the Mk. I are to become constant-chord on the Mk. II. Elevator area is to be increased and elevator tip planform slightly altered. A degree or so of dihedral is shown on the Mk. II wing.

Door, window and cockpit outlines have been altered for the Mk. II.

Douglas Skyraider Gets Faster De-Icer

Faster cycling for more efficient ice removal is the feature of a new improved pneumatic de-icing system developed for the Douglas AD Skyraider series.

Designed by B. F. Goodrich Co. in collaboration with the Navy's Bureau of Aeronautics and Douglas engineers at El Segundo, Calif., the system is said to be more efficient than any previous device in breaking heavy ice.

It was discovered that by using smaller air tubes, higher air pressure and a faster inflation-deflation cycle, ice formations could be broken up more rapidly. So, the expanding air supply tubes were reduced to 1¼ in. dia. and pressure increased from 7 to 15 psi.

A manifold system provides pressure and vacuum for speedier inflation and deflation.

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L-M offers a complete engineering service for airports on runway lighting. L-M airport engineers know the lighting problems. What's more, they know the problems of the pilot as he comes in for a landing. They know what happens to runway lights under minimum and emergency conditions—the effect of fog, daylight snow, rain, and dust—and how far light can penetrate these conditions. That experience is valuable—it's available to you!

L-M Field Engineers throughout the country are backed by experienced district lighting engineers and a complete engineering staff at airport lighting headquarters.

To get this service, fill out a copy of the Engineering Data Check sheet shown below. You can get this sheet by asking the L-M Field Engineer who calls on you, or by writing Line Material Company, Airport Lighting Division, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

SOME L-M-LIGHTED AIRPORTS

L-M runway lighting is in operation at small, medium, and large airports all over the world. With its various types of units L-M can serve practically any airport. Below are listed some of the principal airports with L-M High Intensity Runway Lighting. Most of these have the latest-type 180,000 candlepower unit with the famous L-M controllable beam, some have the fixed focus type. In addition there are many, many airports with L-M medium-intensity units. If you are interested, ask for a list of L-M-equipped airports in your area.

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Boston
Windsor Locks (Hartford), Conn.
New York (La Guardia)
New York International
Newark
Philadelphia International
Raleigh, N. C.
Winston-Salem, N. C.
Columbus, O.

South Bend
Indianapolis
Lansing
Battle Creek
Chicago
Milwaukee
Madison
Minneapolis-St. Paul
Sioux City, Ia.
St. Joseph, Mo.

St. Louis
Tri-Cities Airport, Tenn.
Chattanooga
Knoxville
Nashville
Jackson, Miss.
Birmingham, Ala.
Jacksonville, Fla.
Oklahoma City

Rapid City, S. D.
Phoenix
Salt Lake City
Arcata, Calif.
Pocatello, Idaho
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L-M's famous 180,000 cp controllable-beam high intensity runway light, type L 818.

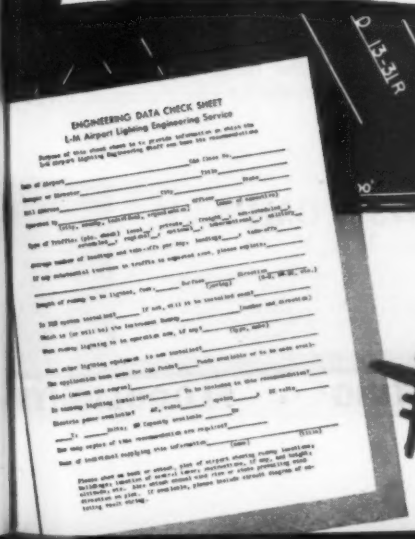
L-M high intensity unit with fixed focus, type L 819.

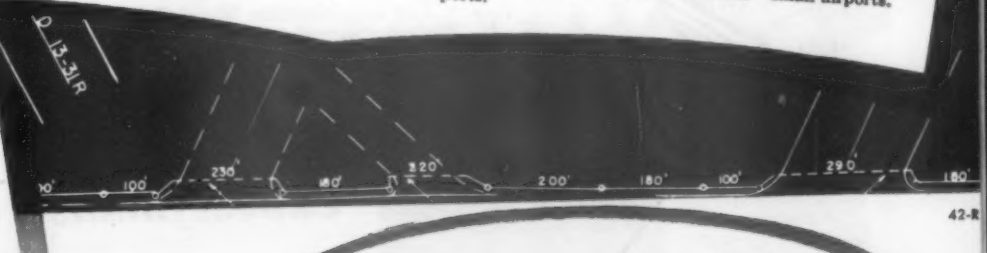
L-M medium intensity runway light for smaller airports, and for taxiways at larger airports.

L-M revolving beacon for Class I, II, and III airports.

L-M marker and obstruction lights, single or double.

L-M control panels for large and small airports.





42-R

Get this Engineering Data Check Sheet Free

A simple way to check the information and data on which to determine the runway lighting requirements for your airport. Sent free on request to airport managers and others concerned with runway lighting installations.

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COMBINATION

WIND CONE

...gives pilots quick and accurate information

It is essential that the pilot of an incoming plane obtain all landing information... QUICKLY! To accomplish this the segmented circle was devised . . . an easily spotted location from which a pilot obtains all visual information on wind direction and traffic control. It is present practice of CAA to require the wind tee and wind cone to be mounted within the segmented circle. Where the wind tee is of the operator control type, it will be essentially a traffic control device while the wind cone will show true wind direction.

Experience has shown that when the wind tee and wind cone are both mounted on the ground inside the circle the pilot's view of one is obstructed by the other at certain angles. It is also difficult to tell whether the wind cone and the wind tee are pointing in exactly the same direction. This difficulty is overcome by mounting the wind cone on top of the wind tee. With the wind cone on the wind tee any difference in the directions indicated by the two devices is apparent.

Crouse-Hinds Type WC-18 No. 44593 Wind Cone and Lighting Fixture Assembly can be attached to some types of existing Crouse-Hinds Wind Tees. The support consists of two heavy steel angles which are bolted to the square plate that forms the top of the shaft of the tee.

The Combination Wind Cone and Wind Tee is built to Crouse-Hinds high standard of quality . . . from the finest materials, with painstaking care, by skilled craftsmen. This is one of the items in Crouse-Hinds complete line of lighting and control equipment for every airport, large or small.

Write for additional information.

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and WIND TEE

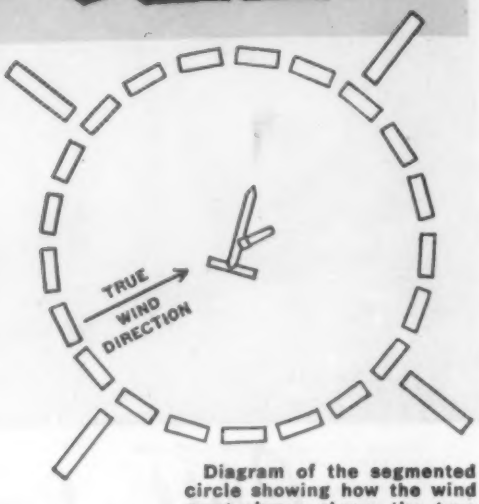
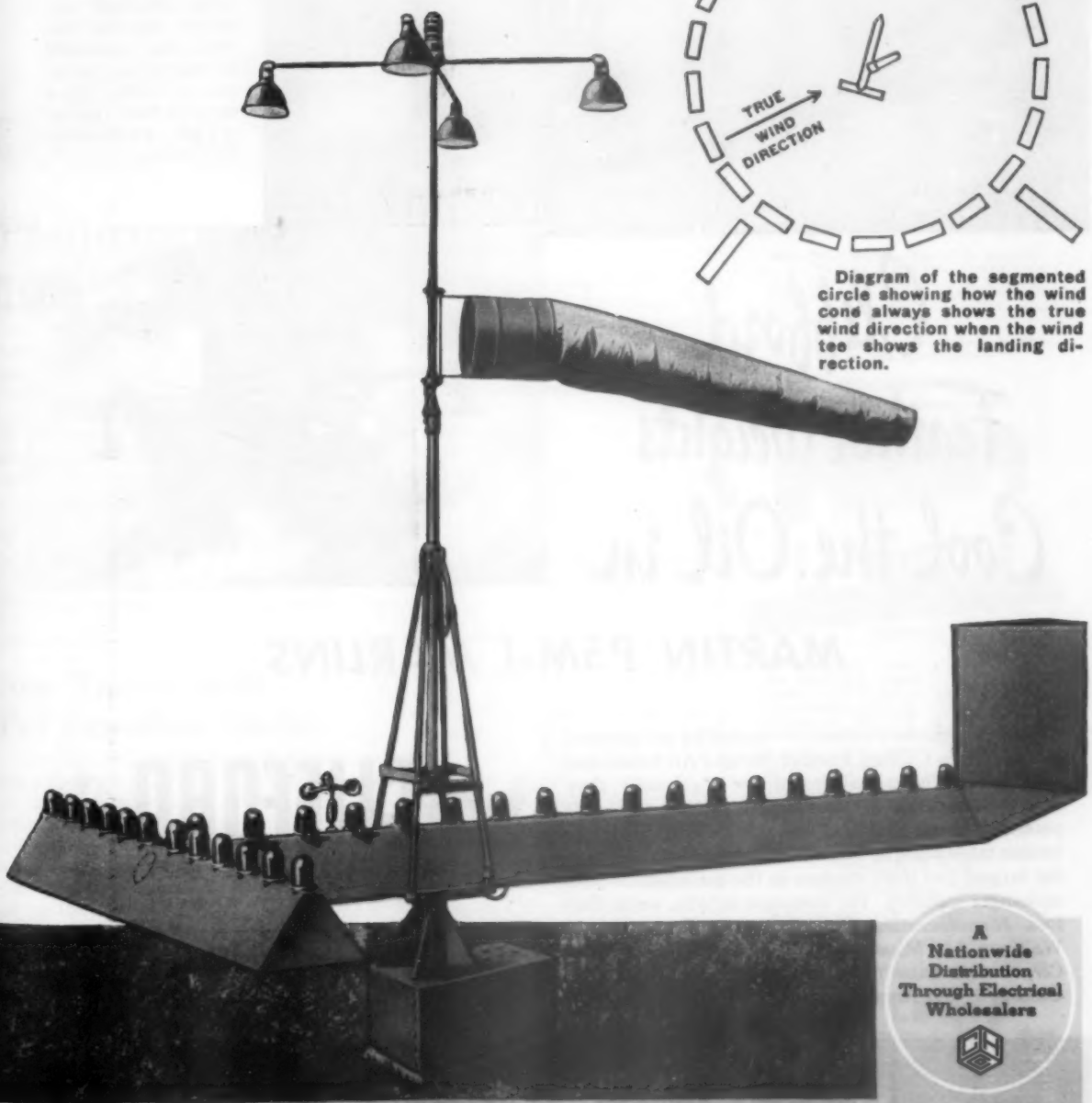


Diagram of the segmented circle showing how the wind cone always shows the true wind direction when the wind tee shows the landing direction.



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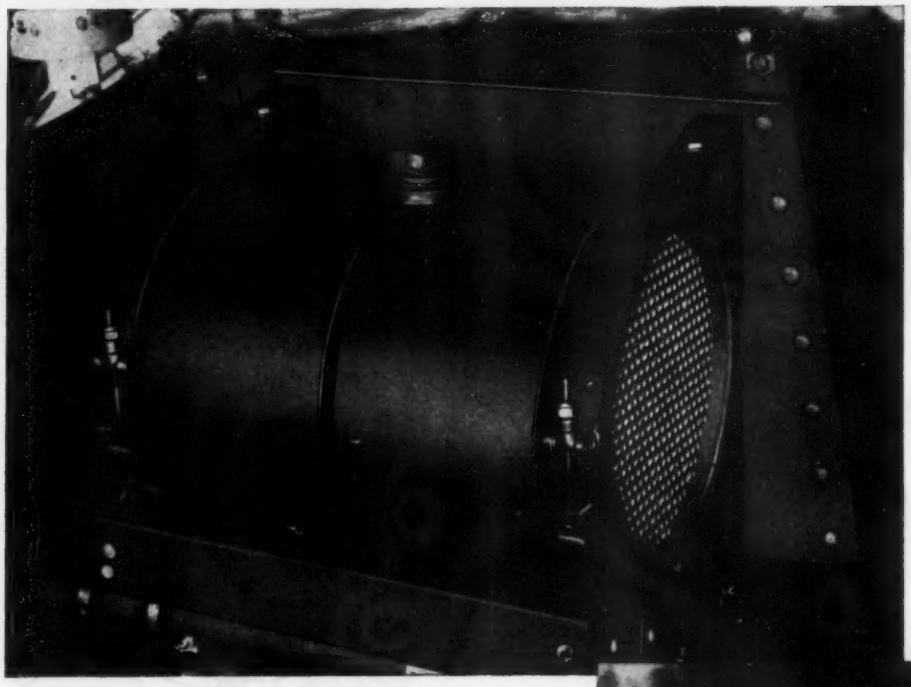

DEATH TO ENEMY SUBMARINES. Martin anti-submarine seaplanes feature a new type of hull in which the keel is under water from nose to tail. Equipment includes latest electronic submarine detection devices plus armament for destroying undersea raiders. They carry Clifford Feather Weight All-Aluminum Oil Coolers.

Clifford Feather Weights Cool the Oil in

MARTIN P5M-1 MARLINS

All types of modern aircraft — including jet powered — depend on Clifford Feather Weight All-Aluminum Oil Coolers. *The only all-brazed type of oil cooler*, they owe their superior weight-strength ratio to Clifford's patented brazing method and pre-testing. This pre-testing takes place in Clifford's wind tunnel laboratory, the largest and most modern in the aeronautical heat exchanger industry. For complete details, write Clifford Manufacturing Company, 136 Grove Street, Waltham 54, Mass. *Division of Standard-Thomson Corporation*. Sales offices in New York 17, Detroit, Chicago 1, Los Angeles.

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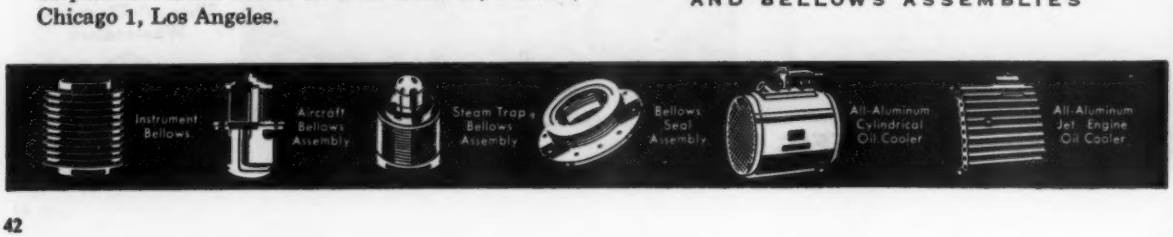


Photoangulator Fixes the Slant

The photoangulator–a device to give true horizontal directions from oblique aerial photographs–has passed operational tests at the U. S. Army's Engineer Research and Development Laboratories, Fort Belvoir, Va.

For aerial mapping or surveying, most of the source material comes from photos made with three cameras. These shoot one vertical and two oblique photos simultaneously.

With the photoangulator, a network of intermediate horizontal control is established.

There are three principal parts to the device–a depression angle assembly, which adjusts for the depression angle (below the horizon) of the camera at the time of exposure; a transparent photo arm under which control points are intersected; a template arm that lies over the map and indicates the true horizontal directions.

The instrument differs from the current Corps of Engineers angulator and the Air Force rectoblique plotter because it furnishes a trigonometrical solution. The other two units produce a geometric solution.

The instrument has been standardized for issue to Engineer topographic troops.

New Tunnel Built For Canadian Studies

Canada's aeronautical research potential will soon be bolstered by acquisition of a new high-Mach number test facility.

Working section of a 5,000-mph. windtunnel recently has been completed for the National Research Council by the Dominion Bridge Co. Ltd. of Canada.

The facility will draw on nine nozzle boxes, each with a different Venturi shape and interchangeable, for nine separate speed conditions, depending on the box in use.

Box 1 is rated for a Mach 1.4 air speed, boxes 2 to 6 will afford a progressive range up to Mach 3.47. The remaining three boxes will be built by NRC and will advance the speed to a high of 5,000 mph. for the ninth individual box.

The tunnel will operate on the suction principle, using a 35-ft.-diameter evacuated sphere. Test section of the facility is 10 in. square.

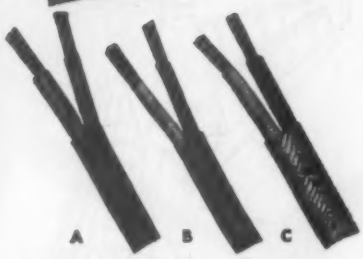
One end of the nozzle box projects into the balance box, which houses the model and measuring apparatus. Both these sections are fitted with 1¼-in.-thick glass for observation or schlieren-photography of flow phenomena.

When the nozzle box is removed the balance box can be moved forward to give easy access for model change and apparatus adjustment.

The adjustable throat, which follows the balance box, has aluminum plates for roof and floor flexed by screwjacks to give heights ranging from 6½-12½ in. This gives pressure adjustment inside the balance box and increases efficiency of pressure recovery.

LEWIS

Thermocouple Lead-Wire



IRON CONSTANTAN — Figure A, lead-wire to specification AN-W-8. Available in type II or III class A or B. Thermocouple wire supplied in AWG sizes from 18 to 30 to Bu Stds RP1080.

COPPER-CONSTANTAN—Figure B, lead-wire used with chromel-alumel indicators, effects considerable saving in weight over chromel-alumel leads of same resistance. Available in AWG sizes or with special stranding to seven ohms per 200 feet.

CHROMEL-ALUMEL—Figure C, lead-wire to specification AN-W-29. Available in types I, II or III class A or B. Available with stainless steel overbraid. Thermocouple wire available in AWG sizes 16 to 24.

Write for data on any of above or wire to new MIL specifications.

ACCESSORIES FOR TEMPERATURE INDICATORS

AN5534-1

Developed by Lewis, the AN5534-1 resistor block is used to adjust the overall external resistance of the indicator to eight ohms.

AN5537-1

Another Lewis development, the AN5537-1 Firewall Connector Block provides a quick disconnect for thermocouple engine leads. Available with angle plugs as part AN5537-2.

TERMINALS FOR THERMOCOUPLE LEADS

In accordance with AN5539 in brass as well as chromel and alumel. In addition, we manufacture chromel and alumel terminals with longer insulation grips in accordance with the new AN5548 standards.

THE LEWIS ENGINEERING CO.

Manufacturers of Complete Temperature Measuring Systems for Aircraft

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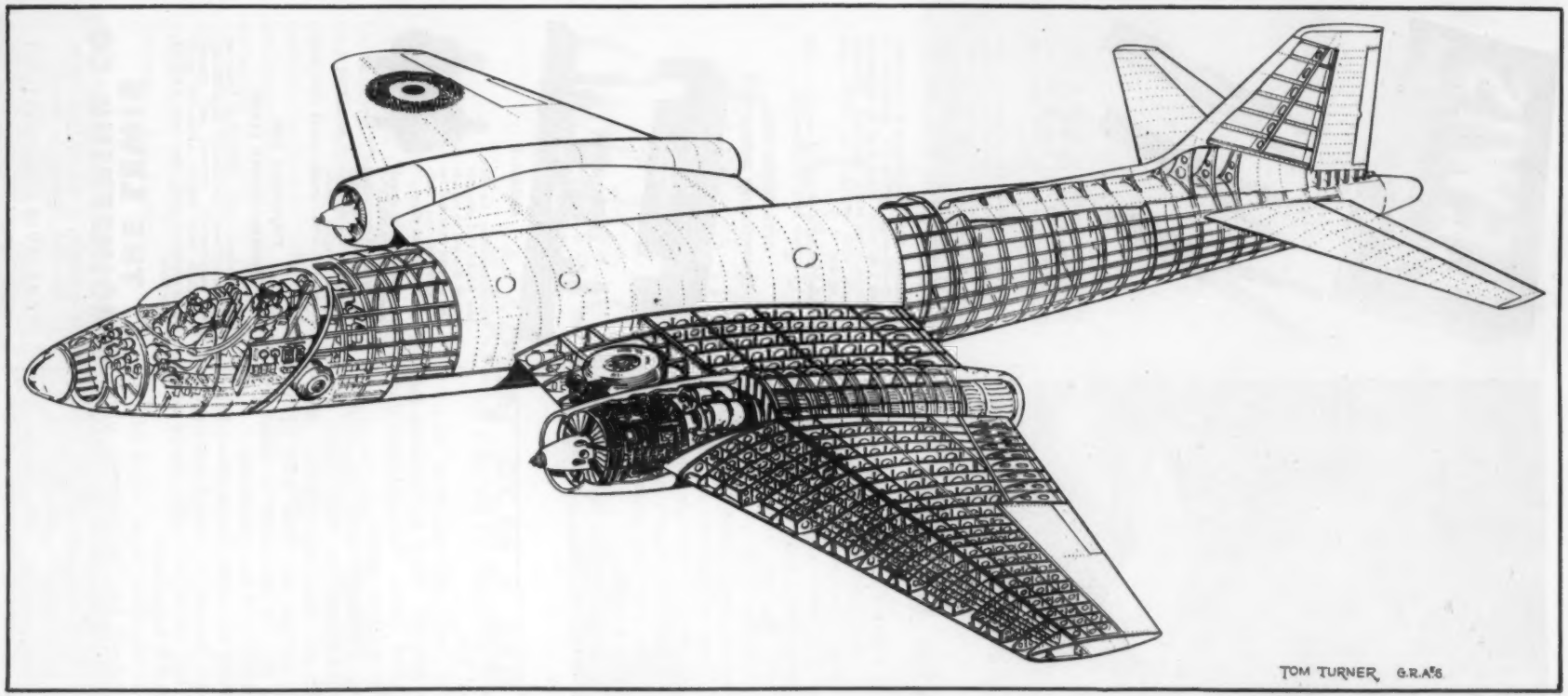

Aviation Week Design Study: Canberra Mk. 2

Increasing interest is being displayed by U. S. aeronautical circles in the general configuration and structural makeup of English Electric's B. Mk. 2 Canberra now that this high-subsonic, medium-altitude, visual bomber will be built as a night-intruder for the USAF by the Glenn L. Martin Co. (AVIATION WEEK July 23, p. 19).

This skeletonized view of the British bomber points up its rugged simplicity and indicates high producibility, emphasized by the practically cylindrical fuselage section extending from aft of the cabin back to the tail.

Cockpit is comparatively small for a three-man crew (pilot, navigator and bombardier), but compactness of installations and elimination of all but "essential" equipment obviates cramping. Space alongside pilot is vacant to allow bombardier to leave his aft seat alongside navigator and go forward into the nose in a prone position. Nosewheel installation, moved aft behind cockpit, leaves nose space clear.

The wing butts directly against the fuselage and nacelles to eliminate fillets, employs no anti-icing or de-icing features. Integral fuel tankage is used, and leading edge top between nacelle and fuselage is hinged over equipment installations. Sweep of outer wing panel's leading and trailing edges is unsymmetrical. Outer panels are fitted on top and bottom with finger-type dive brakes, flushed into the wing surface when retracted. Extended, they present a series of rectangular block forms with concave fronts facing the airstream for effective drag.

Control surfaces are torque-tube-actuated to eliminate cable tensioning problems. Horizontal stabilizer is adjustable.

Engines are Rolls-Royce Avon Mk. 1. Apparently the inlet guide vanes, like those on the recently announced General Electric J-47-GE-21, are adjustable. A cartridge-type starter, fired from the cockpit, is fitted in the nose of the air inlet bullet. The combustion efficiency of the R-R jet is indicated by the report that no sooting of the tailpipe is in evidence after engine operation.

The plane stands low to the ground and affords excellent maintenance access. Entrance to the cockpit is through a large up-hinged door easily reached from the ground. Standing erect, a mechanic can see and reach into the main landing gear wheel-well. Nose section of the plane is at approximately shoulder height. A large panel gives quick access to electrical installations in the fuselage side, while an adjacent door opens up for easy reach to the tray-supported batteries.

Martin's version (B-57A) will be heavier because of necessary changes incorporated for USAF service, but it will be fitted with higher-thrust jets (probably Wright Aeronautical J-65 Sapphires). Tailcone of B-57 will be extended slightly to house a braking chute.

Ignition Headquarters

. . . for PISTON, JET and TURBO JET ENGINES

Bendix experience extends to every phase of aircraft propulsion. For more than twenty-five years problems of ignition for every type of aircraft engine and operating condition have found their solution in the resources and skill of Bendix. That's why the aviation industry has come to consider Bendix the one source *uniquely qualified* to design and produce ignition equipment to meet every operating requirement.

No single type of ignition equipment is the final solution to every operating problem. Let Bendix experience help you determine the type of ignition equipment best fitted for your purposes.

Write for an interesting booklet entitled "Current Aircraft Engine Ignition Systems."

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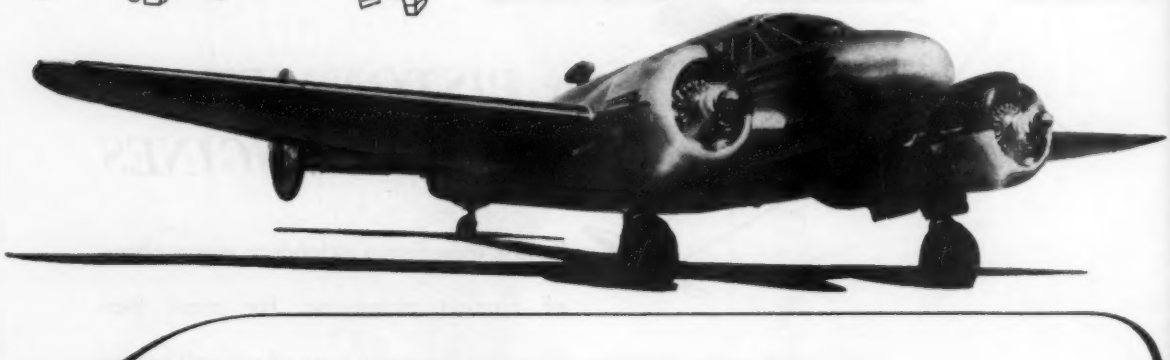
951

William Johnson finds it easy to do "double duty"

Mr. Johnson has an important desk job as General Manager of Charles B. Johnson, maker of sizing machines for textile mills. It's vital that he and other key men make field trips, too. The company's Twin-Engine Beech Executive Transport and Beechcraft Bonanza allow them to do *both* jobs. They clip travel time as much as 75%! Today, with mills filling government contracts, these Beechcrafts help keep production rolling. Example: A Johnson Sizer in a deep-south mill after long operation needed a replacement part. Thanks to Beechcraft "special delivery," the machine was idle just four hours!



The sleek, unsurpassed Beech "Twin" is a familiar sight on all the world's airports. Its versatility, reliability and high performance characteristics have been proved in service of leading industries and the Armed Forces. The cabin is comfortable and soundproofed—with several custom-interior plans available. With maximum speed of 230 mph, the Beech Executive Transport gives executives complete mobility of action, any time, any season. See your Beechcraft distributor for details. Or write Beech Aircraft Corporation, Wichita, Kansas, U. S. A.

- Cruising speed, 200 mph
- Range up to 900 miles
- Service ceiling, 20,500 feet
- Seating arrangements for 7, 8 or 9

BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS

NACA Reports

▶Preliminary Investigation of a New Type of Supersonic Inlet (TN 2286)—by Antonio Ferri and Louis M. Nucci.

The practical use of a high Mach number ramjet or turbojet for aircraft depends almost entirely on obtaining a very high pressure recovery from the air inlet.

The history of the design of the diffusers having a fixed geometry and internal supersonic compression has led several investigators to believe that better results can be obtained with either variable-geometry diffusers or diffusers with external supersonic compression. The first work in this direction was begun by the German scientist Oswatitsch; but before his work was known in the United States, some independent work had been started at NACA using different criteria.

Some results of the NACA work are in this report, which was originally issued as a classified document in 1946.

In contrast to the work of Oswatitsch, the NACA faced the problem of designing an inlet for a supersonic airplane. This meant a large operating range of Mach number and continuity of flow phenomena. The range of Mach number for the NACA work was lower than the range considered by Oswatitsch. Consequently, an inlet which had all external supersonic compression for the condition of optimum pressure recovery was chosen.

The use of the all-external supersonic compression type of inlet, gives the following advantages and disadvantages in comparison with earlier inlet types:

- The constant-geometry inlet can operate with high pressure recovery for a large Mach number range.
- Large variations of mass flow do not present discontinuities of pressure recovery.

▶An Experimental Investigation of the Effect of Surface Heating on Boundary-Layer Transition on a Flat Plate in Supersonic Flow (TN 2351)—by Robert W. Higgins and Constantine C. Pappas.

Since the available information on the effect of surface heating on boundary-layer transition is limited in scope, the authors felt that additional experimental data, especially for flat plates and supersonic flow would be desirable. Windtunnel tests were performed at a nominal Mach number of 2.40. Data was obtained at nominal plate temperature levels of 60F, 140F, 180F and 260F.

▶The Effect of an Arbitrary Surface-Temperature Variation Along a Flat Plate on the Convective Heat Transfer in an Incompressible Turbulent Boundary Layer (TN 2345)—by Morris W. Rubesin.

This analysis, which is rather thoroughly described in the title, utilizes five assumptions:

- All physical properties of the fluid are constant.
- Negligible frictional dissipation of energy within the boundary layer.
- Boundary layer velocity distribution of the 1/7 power form.
- Boundary layer temperature distribution of the 1/7 power form.
- Local heat-transfer coefficient for a constant-surface temperature plate applies to the case of variable temperatures, when expressed by an equation based on the local flow and thermal boundary-layer thicknesses instead of the distance along the plate.

The analysis and cited examples indicate that a variation in surface temperature along a flat plate influences the local convective heat transfer, depending on the type of variation. Generally, a sudden surface temperature discontinuity produces extremely large changes in the convective heat transfer directly downstream of the position of the discontinuity.

A continuously variable surface temperature was shown generally to have

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it's simple
it's GOOD

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Disc-type construction—delivers either of two inlet pressures from outlet port, depending upon which is the higher. Light, simple, and efficient; provides an excellent means for a dual air supply to an operating device.

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2. Burst Test—2250 psi.
3. Max. Operating Pressure—1500 psi.
4. Ambient Temperature Range—+160 degrees F. to —65 degrees F.
5. Max. Leakage Rate—5 to 500 psi. 60 cc/min. Free Air 500 to 1500 psi. 80 cc/hr. Free Air
6. Tube Connections in accordance with AND 10050
7. Available in ¼" x ⅜" tube size.

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AIRCRAFT DIVISION
WILMERDING, PA.

a smaller effect on the convective heat transfer than a sudden temperature discontinuity. For this same case, large effects on the local heat-transfer coefficient could be expected only where the surface temperature approaches that of the free stream at a point other than the leading edge of the plate.

▶ Comparison of Theoretical and Experimental Response of a Single-Mode Elastic System in Hydrodynamic Impact (TN 2343)—by Robert W. Miller and Kenneth F. Merten.

Experience with large airplanes has shown that a critical design consideration may be the elastic behavior of the structure during landing impact. Most of the analytical methods for treating this case assume that the external load applied during the impact is not influenced by the elasticity of the structure. They further assume that the structural response can be determined from the load that would have been applied if the structure were rigid.

A previous NACA technical note presented an analytical method for treating the hydrodynamic impact of an elastic structure in which the interaction of the load and response were included. That report showed that structural flexibility could have appreciable effect on the applied load.

In this regard, the significant flexibility of the structure is considered to be the flexure of the fuselage-wing structure in the fundamental mode. This action can be represented by a two-mass-spring system having the same frequency as the fundamental mode of the represented structure, and a mass ratio determined by the physical characteristics of the structure. No adequate experimental check was made of this earlier method, so water impact tests of an elastic model approximating the two-mass-spring system were made at the Langley impact basin.

The results of the tests are compared in the report with theoretical time histories of impact force and response calculated by the method presented in the earlier NACA report. This earlier method considers the applied hydrodynamic load and the structural response to be interdependent or coupled throughout the impact. Force-time histories for the elastic system and the rigid system are compared. These comparisons indicated that the theoretical results agreed well with the experimental results.

▶ Spin-Tunnel Investigation of the Effects of Mass and Dimensional Variations on the Spinning Characteristics of a Low-Wing Single-Vertical-Tail Model Typical of Personal-Owner Airplanes (TN 2352)—by Walter J. Klinar and Jack H. Wilson.

This report covers part of a general investigation being conducted in the Langley 20-foot free-spinning tunnel to provide design information for proportioning personal-owner or liaison airplanes for satisfactory recovery from spins. Earlier series of tests were made on a twin tail model; another phase of the over-all investigation was the presentation of design charts for proportioning aircraft for satisfactory spin recovery.

This investigation was conducted to provide airplane designers with spin and recovery data for a variety of design configurations. The results of this investigation have also been examined in light of the requirements set forth in Civil Air Regulations, Part 3.

The investigation showed that even if the tail-damping power factor (defined by A. I. Neihouse in NACA TN 1329, 1947) is not very great, satisfactory recovery characteristics can be obtained readily. The technique which must be used is full, rapid rudder reversal, followed about ¼ turn later by forward movement of the stick.

A variety of tests was made, including tests with changes in mass distribution of the airplane, vertical or horizontal tail design, tail-damping power factors, wing plan form, and center of gravity.

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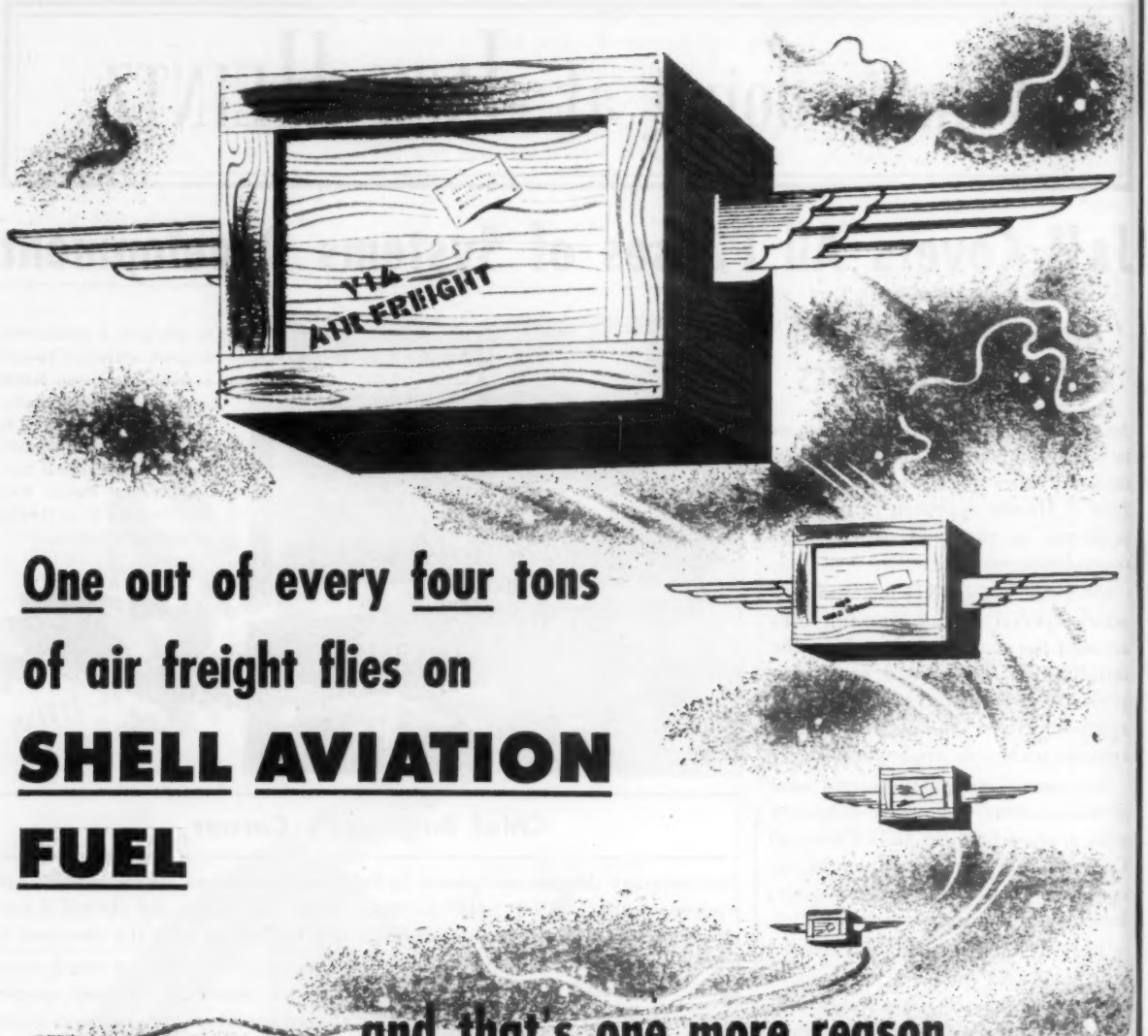

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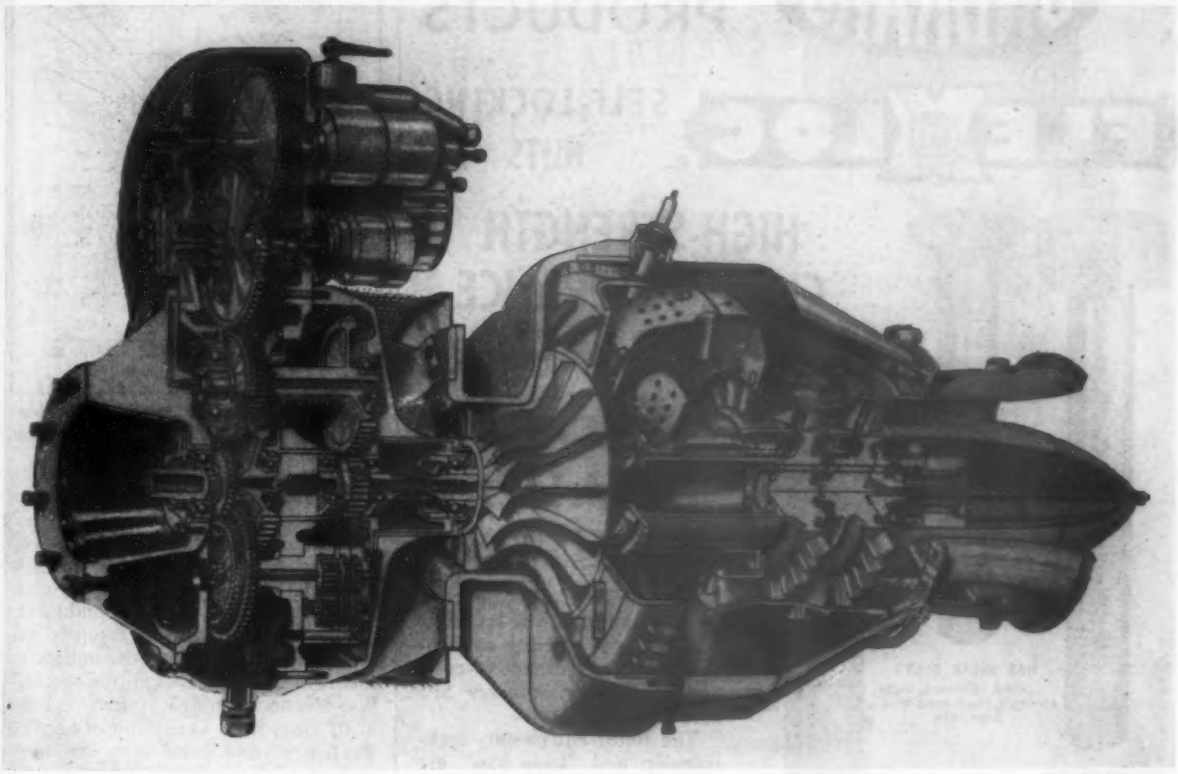

CUTAWAY view of the Turbomeca Oredon gas turbine. Fuel enters engine through hollow main shaft. Hollow nozzle blades permit air to flow back to combustion chamber, and hollow tail cone supports conduct air to rear bearing for cooling.

Stratos to Produce French Baby Turbine

Developing 140 shaft horsepower, engine has potential use for pumps, starters and other auxiliary applications.

By George L. Christian

Farmingdale, L. I.—A new 140-shaft horsepower gas turbine of French design will soon be manufactured and sold in the U.S. for a wide potential of auxiliary power applications.

Stratos division, Fairchild Engine and Airplane Corp., has just negotiated an exclusive licensing agreement with Turbomeca, of Pau, France, to build and sell the machine, dubbed "Oredon," in America. This is the first agreement ever negotiated between an American and French company involving licensing for gas turbine construction.

Currently used to power an Alsthom alternator rated at 35 kw., 44 kva., 110/208 v., 400 cycles ac. at 6,000 rpm., the turbine has enough muscle to handle 90 kw. dc. generators. Unit may also be equipped with a 12,000 rpm drive. And it has innumerable other potential applications. The engine is roughly comparable to the successful pint-size, 175-hp. gas turbine model 502 developed by the Boeing Airplane Co.

▶ **Turbine Features**—Here are some of the Oredon's features which attracted Stratos.

- Combustion chamber is the annular type. Dual spark plugs assure prompt ignition at starting.
- Fuel is injected into the center of the main rotating shaft at the accessory section and it flows through the shaft to the combustion chamber into which it is sprayed through a slinger ring. Air bled off the compressor forms an effective air seal at the point where fuel is transferred to the rotating shaft.
- Turbine nozzle, disc and buckets are made of non-critical metals.
- Low operating temperature of 1,382 deg. F. (at turbine inlet) made it possible to make use of non-critical metals.
- Specific fuel consumption is moderate—1.04 lb./shp./hr.
- Constant speed of the unit makes it particularly attractive as an alternator drive. Variation of rpm. is 0.4% in the steady state, load or no load. No data are available now for variable load conditions.

▶ **Compact and Reliable**—The Oredon is relatively compact. It measures 31.7 in. overall, 20.5 in. max. diameter and weighs 185 lb. including reduction gearing.

Reliability of the engine is indicated by its current 500-hr. overhaul period. Stratos says that a 1,000-hr. overhaul period should be feasible.

Albert Beaufrere, Stratos Chief Gas Turbine Project Engineer, summed up the engine's virtues this way: "Due to high component efficiencies brought about by good hydrodynamic design of the combustion chamber and compressor (the latter being 80% efficient) the

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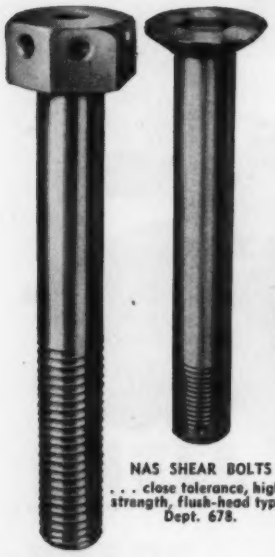

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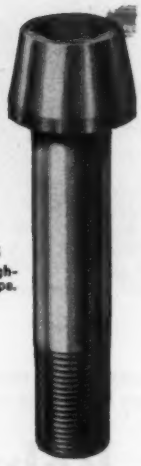

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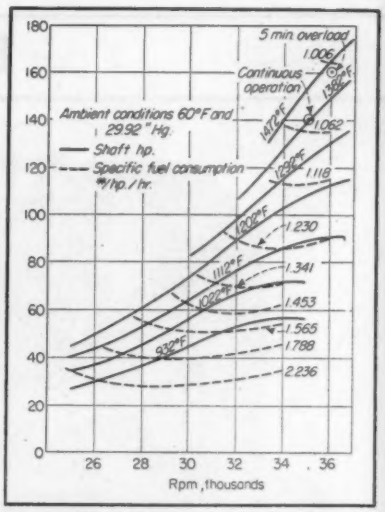

TURBOMECA's gas turbine "Oredon" shaft hp. and specific fuel consumption.

machine is capable of operating at low specific fuel consumptions and the low turbine temperature of 1,382 deg."

Trick used by the French to keep the machine relatively cool is to blow some of the air furnished by the compressor over the annular combustion chamber. Air then flows through hollow nozzle blades, along the outside of the main shaft and back to the combustion chamber through a series of holes in its lower face. One result of keeping the temperature down is an engine of exceptional ruggedness.

▶ **Bright Potential**—Although Stratos has no definite plans for its adopted child, considering it more as a development unit, there are many applications to which the Oredon seems well suited. Aside from driving ac. and dc. generators, either on the ground or as airborne units, the engine could be used as a portable source of air to start jet engines. Two or three men could conveniently move the unit. Because it packs so much power for so little space and weight, it could be used as a high speed field power package to pump fuel from container to container or from container to vehicle (truck, tank, plane). And it could be used to power a lightplane in a turboprop installation, or even propel an automobile or a boat.

▶ **Inside Dope**—The gas turbine power plant is based on Szydlowski patents and consists of these major components:

• **Compressor**—Single sided, centrifugal flow type impeller with 16 vanes pushes air past a fixed diffuser ring and guide vanes through an annular duct outside the compressor turbine drive shaft into the combustion chamber. Compression ratio is 3.4:1, air mass flow 2.7 lb/sec. at 35,000 rpm at sea level.

• **Combustion Chamber**—Engine contains one annular combustion chamber with perforated and baffled flame cham-

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ber of Nicral D alloy. Fuel is injected through a rotary disc.

• **Turbine**—Axial flow, two-stage type, fabricated steel casing with 20 nozzle guide vanes and 27 stator blades of Z1-CNT-18 steel. Two rotor discs made of Noxis 4 or ATVS 7 steel bolted together. Each mounts 23 inserted blades of same material: Gas temperatures are: 1,382 deg. before turbine and 1,022 deg. after turbine at 35,000 rpm.

• **Exhaust nozzle**—Variable area type. Outer casing is steel and inner cone is movable. Outlet diffuser releases gases at a maximum speed of 330 ft./sec. (The unit under study at Stratos did not have the variable exhaust nozzle feature).

• **Fuel System**—Low pressure system. Fuel is sprayed by centrifugal force through nine holes in the rim of a ducted injector disc mounted on the hollow compressor-turbine drive shaft which serves as fuel manifold. Fuel is supplied under pressure by one Martin-Moulet four-vane fuel pump at 57 psi.

• **Control system**—Turbomeca automatic, fly-ball type governor maintains speed within 0.4% of desired rpm.

• **Lubrication**—Dry sump system. Turbomeca pump supplies oil at 21 psi. Two scavenge pumps are provided, one for the front the other for the rear bearing. A centrifugal pump is supplied to prevent the oil from emulsifying. Normal oil consumption is 0.4 lb./hr.

• **Starting system**—A two hp. electric starter is provided, also a booster coil and two igniter plugs. Engine is started and operated entirely on JP-3 jet engine fuel. French started the engine on gasoline, then switched to kerosene.

• **Rating**—Maximum, for five min.: 160 shp. at 36,000 rpm. at sea level. Normal, for continuous operation: 140 shp. at 35,000 rpm. at sea level.

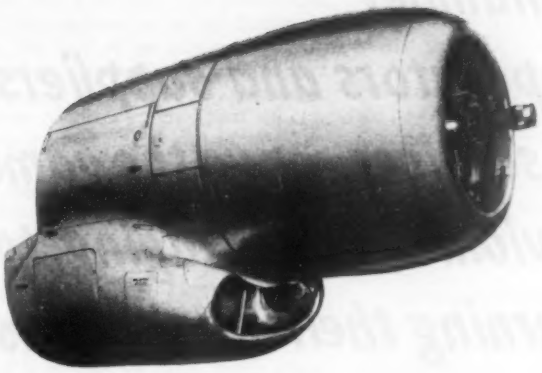
• **Provisions**—Main power take-off may be provided with reduction gear ratios of 5.75:1 or 11.5:1. Accessory section provides for three additional power take-offs plus a tachometer pad.

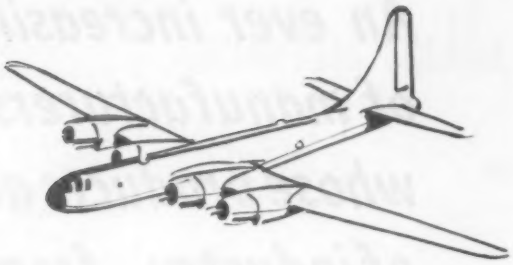
• **Mounting Points**—Three shock-absorber mounting pads are provided, two on the gear reducer housing and one in the low section behind the sheet metal combustion chamber housing.

A feature of the rear bearing is air cooling. Outside air is induced to the bearing through three hollow struts supporting the tail cone, thus reducing its temperature appreciably and promoting longer life.

The bearing supports are articulated at both housing and bearing attachment points to permit the bearing to expand and contract with heat variations without imposing stresses on the machine's structure.

▶ **The Reason Why**—Asked why Stratos





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undertook to build the Oredon under license, the firm's engineers pointed out that the turbine permitted Stratos to enter the field of gas turbine construction with a tested unit ranking with the best on the market in a minimum of time. Moreover, this type of construction fitted neatly into Stratos' specialty of designing and building small size, high speed, bleed air turbo machinery. The Oredon will be the first Stratos turbine with a fire in it.

TWA Shifts Radio Repair to N.Y. Firm

Much of TWA's radio repair work, formerly done at Kansas City, has been given to a New York concern as a result of the Kansas City flood that inundated the carrier's main overhaul facilities. The company is Smith Meeker Engineering Co. Mars Radio is also getting a share of TWA's radio overhaul work.

Fred Woodward, Smith Meeker's chief engineer, told AVIATION WEEK that it started overhauling TWA's radio equipment as soon as the airline was hit by the flood. To date it has done over $5,000 worth of business, he estimated. It marked the first time Smith Meeker had contracted for volume airline work.

▶**Other Aero Work**—But aircraft radio repair, electrical design, engineering and installation are not new to the company. Starting some 45 years ago with specialized marine electrical and radio work, Smith Meeker branched out into the aeronautical field immediately after the last war. First jobs were custom design and installation of complete radio systems in executive aircraft. This soon led to maintaining the equipment originally installed plus radio gear put in by other shops.

Next step beyond exclusive radio installation and repair was rewiring entire electrical systems. Examples are Eastman Kodak's and Prince Bernhardt of Holland's DC-3s, which were converted from 12 to 24v. systems. Complete radio systems were also installed.

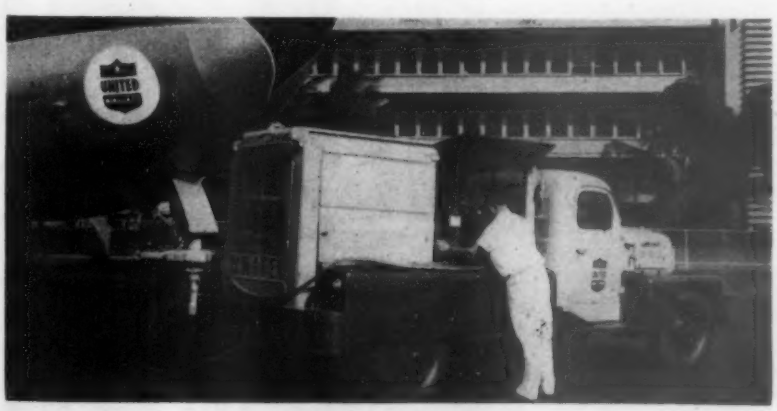
▶**Overhaul Shops**—Smith Meeker has its overhaul shops in the Mallard Air Service hangar at Teterboro, N. J. There it has built special panels in its screen room to test almost every known type of aircraft radio equipment. And spare panels exist to accommodate new units as they are introduced on the market.

C. J. Myers pointed out a Collins Test Set 479-U-1, saying that except for airline-owned units, it was probably the only such piece of equipment available on the East Coast to test certain radio gear. The set will check ILS in the 90- and 150-cycle phase system. It will also test the entire range of omni equipment and all communications frequencies from 100 to 140 mc.

Woodward cited a job recently done on a large oil company's DC-3 as the most elaborate radio installation ever made by his company. It included 2 Collins 18-S transceivers, 1 Collins 51-R2 omnirange set complete with OBI and RMI for navigation, 1 Collins 51-R2, 1 Collins 51-V1 glide path receiver, 1 Collins 17-L2 180-channel VHF transmitter, 2 Bendix MN62-A ADF receivers with MN60-A iron core loops, 1 Bendix RA10-DD range receiver with MN-24 loop, 1 Bendix MN53-B marker beacon receiver, and 1 Smith Meeker custom-built cabin radio receiver.

The firm has just received an order to install $30,000 worth of radio equipment in a twin Beech 18.

Although 90% of the company's current business is non-aviation, Woodward believes that this percentage will become more heavily aeronautical in the future, especially since the Kansas City flood floated TWA's business into SM's lap.



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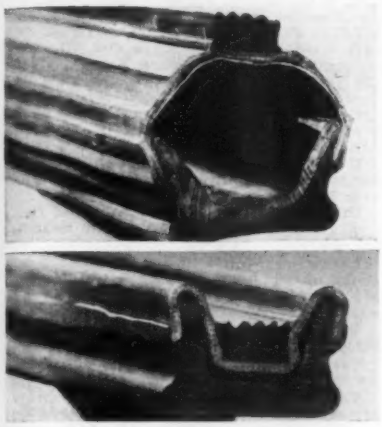


Fighter Cockpit Seal

Devising a practical method of tightly sealing the joint between bubble-type canopies and the fuselage to permit effective pressurization of the cockpit, yet allow easy operation of the canopy, has been one of the knotty problems introduced by high altitude flight.

B. F. Goodrich feels it has solved the problem with development of its new Inflatable Strip Seal. This is essentially a specially fabricated inflatable tube with channel configuration. Special textile fabric, rubber-coated on both sides, is vulcanized in the collapsed position to a flexible rubber channel-type base. When inflated, the rubberized fabric lifts to its maximum sealing position with little or no stretching of the rubber.

Air pressure required for inflation is only a few pounds over that inside the canopy. With this design, the seal is tight enough to insure effective pressurization of the cockpit and prevent possibly disastrous high altitude blowouts, yet exerts only a minimum separating force between canopy and fuselage.

Importantly, the extra high lift ratio of the new seal means more clearance when deflated, permitting easy opening and closing of the canopy. According to Goodrich, the rubber compounds used stay "live" and resist weather aging. The seal has been approved by the Air Force for the most advanced fighter aircraft, the company reports. It also can be used as a weather seal between fuselages and detachable cargo "packs" or pods.

B. F. Goodrich Co., Akron, Ohio.

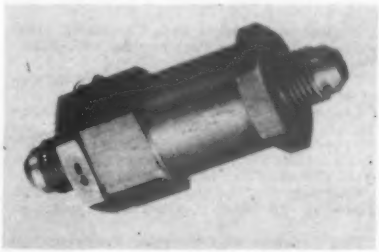
InstrumentComponent

A miniature helical potentiometer, designed to combine "reasonable accuracy at reasonable cost" is being marketed by Van Dyke Instruments, Inc.

The unit, Model H-50, has a 1-ft. resistance element contained in case ½ in. in diameter. The unit is intended primarily for use in precision bridge-balancing circuits and similar applications where the potentiometer is adjusted by means of an insulated screwdriver.

The shaft moves linearly in and out when rotated. Any setting can be maintained at accelerations up to 20G, the maker says. Shaft and wiper are electrically connected. Insulation bushings are supplied for mounting on metal panels. This new potentiometer has a performance now equaled only by instruments several times as costly, claims Van Dyke. Price is expected to be between $2.50 and $3.00 each.

Van Dyke Instruments, Inc., 1927 First Ave., St. Petersburg 1, Fla.



Water Injection Valve

A check valve (plunger type) for water injection systems in aircraft is being produced by Allen Aircraft Products, Inc.

The aluminum-alloy valve weighs less than 3 oz., has a specially treated interior for maximum corrosion resistance. Built for a proof pressure of 1,000 psi. and working pressure of 500 psi., it is spring-loaded in the open position and closes at three psi. reverse pressure. Pressure loss is less than 75 psi. at 60 gpm. Valves spring-loaded in the closed position also are available. All are designed to give satisfactory operation through temperatures ranging from −65 to 250F.

Allen Aircraft Products, Inc., Ravenna, Ohio.

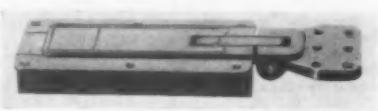
Stronger Filters

Filters for aircraft hydraulic systems, capable of handling pressures up to 3,000 psi. and more rugged than their forerunners have been developed by Purolator.

The new line of filters can be used where pressure pulsations occur. This has been made possible by building them with stronger housing and elements. They are made of aluminum bar stock and meet all specified operating, test and burst pressures, the maker says. Elements, interchangeable with those in comparable units of the same general type series, meet AN-6235.

Filters are available in ½-, 3-, 6- and 12-gpm. models, designated respectively PR-401-2, PR-403-2, PR-406-2 and PR-412-7. Filtration efficiency in these units remain high, says Purolator.

Purolator Products, Inc., Rahway, N. J.



Latch for Aircraft

A flush-fitting, heavy-duty access latch is being manufactured by Simmonds Aerocessories, Inc.

This aircraft latch is a trimmed down, all-purpose version of the High Strength Cowling latch, also produced by Simmonds. It is designed for flat panels, for use on cargo doors, radomes, armament compartments and other access locations. It consists of two sections, the housing and a toggle assembly (no loose parts). Thumb pressure opens the latch.

The unit weighs 3.5 oz., is designed to carry 2,700 lb. breaking load in tension and 5,000 lb. in shear.

Simmonds Aerocessories, Inc., Tarrytown, N. Y.

ALSO ON THE MARKET

Aer-O-Foam 99, liquid type mechanical foam for extinguishing petroleum products fires also is said to be specially effective against fires fueled by menthyl ethyl, isopropyl alcohols, esters, ketones and ethers. National Foam System, Inc., West Chester, Pa.

Timing motor, 400c. hysterisis type synchronous unit, is designed for use as time standard in applications involving relatively light loads. At given frequency, control is better than comparable dc. motor, filtering or shielding is not required, altitude problems are eliminated, maker claims. Haydon Mfg. Co., Inc., Torrington, Conn.

No darkroom is required to produce "black-on-white" photographic intermediates from blueprints—if you use new Kodagraph Repro-Negative paper. Also, using it with companion "Autopositive" paper, you can standardize on positive photographic intermediates in your quantity-print production, regardless of type of originals available, says Eastman Kodak Co., Rochester, N. Y.

USAF CONTRACTS

Numerous contracts listed by Air Materiel Command as worth "over $250,000," were included in the awards announced for the week ended July 20. Total contracts numbered 294, including 125 in the quarter-million-dollar-and-over class. The following completes the list, publication of which was begun last week.

Republic Mfg. Co., Cleveland, bender tube-hand, Cl. 17A, 35 ea., $37,380.

Robertshaw-Fulton Controls Co., Greensburg, Pa., indicators, airspeed, pilot static, sensitive maximum allowable, type L-7A, Cl. 05C, 140 ea., $50,000.

Robbins & Meyers, Inc., Springfield, O., hoists, Cl. 17A, 264 ea., $55,386.

Roller-Smith div., Realty & Industrial Corp., Bethlehem, Pa., analyzers, Cl. 17C, 1,667 ea., $226,528.

Ryan Aeronautical Co., San Diego, facilities for production of J-47 components, over $250,000.

Saf-Way Steel Products, Inc., Milwaukee, engine hoist, type J-1, less winch assy., Cl. 19A, 139 ea., $177,904.

Schacht Steel Construction, Inc., New York, trunk assemblies, Cl. 19A, 60 ea., $27,965.

Seifreat Elstad Machinery Co., Dayton, grinders, Cl. 17A, 11 ea., $233,695.

Sheldon Machine Co., Inc., Chicago, cone heads, Cl. 17A, 100 ea., $91,255; bench type lathes, Cl. 17A, 64 ea., $122,704.

Sikorsky Aircraft div., United Aircraft Corp., Bridgeport, Conn., additional funds, Cl. 01A, over $250,000.

Sorensen & Co., Inc., Stamford, Conn., power unit, type D-2, Cl. 03C-3, 80 ea., unit, type D-2, Cl. 03C-3, 80 ea., $43,200.

South West Welding & Mfg. Co., Alhambra, Cal., marine engine shipping cases, Cl. 19C, 50 ea., $63,750.

Sperry Gyroscope Co., Great Neck, L. I., components of J-2 compass system, Cl. 05A, over $250,000; components of the type E-4 automatic pilot and spare parts, Cl. 05F, over $250,000; instrument landing system & flight recording equipment, $45,829; stator assy., PN-6040-199355, 500 ea., stator assy., PN-2640-288885, 500 ea., $70,245.

Sprague Engineering & Sales, Gardena, Calif., hydraulic test stands, Cl. 17C, 106 ea., over $250,000.

Stamford Electronic Co., Stamford, Conn., signal generators, Cl. 16J, 93 ea., $28,342.

Stanhope Products Co., Brookville, O., antennas, Cl. 16A, 671 ea., $47,239.

Steel Products Engr. Co., Springfield, O., bomb hoists, Cl. 19A, over $250,000.

J. P. Stevens & Co., New York, nylon cloth for parachute repair, Cl. 21, over $250,000.

Stewart-Warner Corp., Chicago, stroboscope, Cl. 17C, 71 ea., $42,626; maintenance parts for special motorized ground vehicles, Cl. 19C, 35 items, $27,937.

Sundstraud Machine Co., Rockford, Ill., machinery & equipment to be used in the production of airplane components, over $250,000.

Sylvania Electric Products, Buffalo, radio transmitters, T-67/ARC-3, Cl. 17A, over $250,000.

Sylvania Electric Products, New York, tube electron RMA type 6095, Cl. 16E, over $250,000.

Technicraft Corp., Kansas City, aircraft covers, Cl. 20, 1,620 ea., $64,196.

Ternstedt division, General Motors Corp., Detroit, components of type N-1, Cl. 05A, over $250,000.

Texas Engineering & Mfg. Co., Dallas, cycle maintenance inspection, Cl. 01, over $250,000.

Thompson Products Inc., Cleveland, overhaul of air turbine fuel pumps, 485, $120,000.

T. L. G. Electric Corp., New York, ammeters, Cl. 16J, 579 ea., $55,500.

Transducer Corp., Boston, radar training set, Cl. 28D, over $250,000.

Transocean Air Lines, Oakland, servicing of all enroute military aircraft designated by MATS at Wake Island, $250,000.

Trav-ler Radio Corp., Chicago, audio oscillator, TS-382A/U, Cl. 16J, over $250,000.

The Trustees of Columbia, University of the City of New York, N. Y., services required for social research methods, $100,000.

United Mfg. Co., Chicago, steel wire, Cl. 23A, over $250,000.

United States Electrical Tool Co., Cincinnati, buffers and polishes, Cl. 17A, 100 ea., $67,360.

U. S. Gauge div., Sellersville, Pa., hydraulic pressure gauges, Cl. 05G, 6,602 ea., $57,052; gauges, oil pressure and fuel, Cl. 05D, 2,159 ea., $47,480; type D-5, Cl. 05D, transmitter torque pressure, 612 ea., $87,195; automatic parachute release, Cl. 20B, over $250,000.

US Naval Ordnance Plant, Indianapolis, overhauling & modernization of the M-9 S/N, Cl. 11A, over $250,000.

Unity Industries, Guthrie Center, Iowa, components of aerial delivery kits, Cl. 20, over $250,000.

University of North Carolina, Chapel Hill, creation of operation analysis stand-by unit, $27,000.

University of Oklahoma, Norman, furnishing of necessary facilities & training for 350 AF personnel as clerk-typists for 12 weeks, $144,900.

Vapor Blast Co., Milwaukee, cleaning cabinets, Cl. 17, 32 ea., $57,970.

Vectron, Inc., Waltham, components of AN/APA-54, Cl. 16A, 97 ea., $65,000.

Vendo Co., Kansas City, Mo., components of aerial delivery kits, Cl. 20, over $250,000; control panels C-403A/A, Cl. 16A, over $250,000.

Vulcan Copper & Supply Co., Cincinnati, hoists, Cl. 17A, 321 ea., $55,169.

WAC Engineering Co., Dayton, dummy load set AN/URM-13, Cl. 16J, 1,884 ea., $30,315.

Wagner Awning & Mfg. Co., Cleveland, aircraft covers, Cl. 20, 1900 sets, $160,996.

Waleo Electric Products Co., Providence, hoists, Cl. 17A, 50 ea., $39,547.

Waltz Furnace Co., Cincinnati, electric heat treating furnace, Cl. 17F, 28 Ea., $61,586; electric heat treating furnace, 24 ea., $52,788.

Wesleyan University, Middletown, Conn., research on photoflash improvement, quality and safety, $49,976; research on photoflash improvement, quality and safety, $49,976.

Western Electric Co., Inc., New York, cavity, Cl. 16, 300 ea., $139,950; attenuators, Cl. 16E, 1,000 ea., $33,130.

Westinghouse Electric Corp., Dayton, type E-9 automatic pilots for F-84F and RF 84F aircraft system, over $250,000; tube electron RMA type 6099 CT: miniature high frequency tubes, Cl. 16E, over $250,000.

Weston Electrical Instrument Co., Newark, indicator, temperature, multi-function, Cl. 05D, 2,227 ea., $88,940.

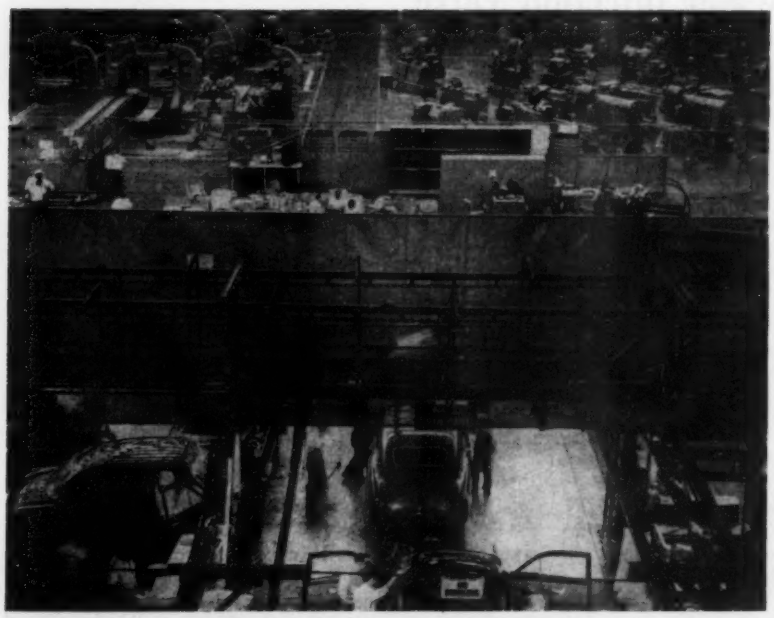
Wickes Engr. & Construction Co., Camden, N. J., terminal area air traffic, Cl. 16B, over $250,000.

Wilcox Electric Co., Kansas City, antennas, Cl. 16A, 2,863 ea., $67,480; components of radio set AN/APN-12, Cl. 16A, 1,185 ea., $30,578.

Worthington Pump & Machinery Corp., Cincinnati, spare parts for 600FM aircompressor, Cl. 17A, 45 items, $51,653.

Wright and Co., Inc., Worcester, Wright & Co.'s standard commercial panel board sections & sorting racks for IBM machines, Cl. 40A, 5 items, $29,775.

Wysong & Miles Co., Greensboro, N. C., motor driven hollow chisel vertical mortizer, 62 ea., $89,032.



FROM CARS TO CARGO PLANES

Just beyond the Kaiser and Henry J. automobile assembly line at Willow Run can be seen hundreds of milling and fabricating machines set up for aircraft production in the plant's 2,000-ft. bay. The factory has been fabricating Fairchild C-119 Packet subassemblies since June 26. The first planes will roll down the assembly lines this fall.

Turco Gets Dy-Chek Exclusive Rights

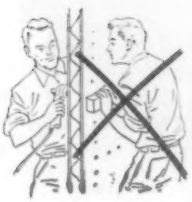
Turco Products, Inc., has been awarded an exclusive license to manufacture and market Dy-Chek, the red dye process which indicates cracks or other flaws in metal. This was recently announced by Northrop Aircraft, Inc., original developers of the process.

Dy-Check has found wide application in the metals industries throughout the U. S. according to Northrop.

Don't monkey around with fragile profits!

Insure production economies with Cherry Rivets

Don't mar surfaces—You won't crack or mar porcelain and other highly finished surfaces with Cherry Rivets. Tool slippage is eliminated...Cherry tools are designed so that the face of the tool always clears the work.



Faster work — Cherry Rivets can be installed by unskilled labor with assurance of permanent and lasting joints. Installing Cherry Rivets is a one-man job . . . done from one side of the work. Cherry Rivets are easy to handle . . . save labor costs.

Tamperproof—Cherry Rivets protect your product against vandalism and carelessness. Yet Cherry Rivets are quickly and simply drilled out with proper tools in the hands of authorized service men.

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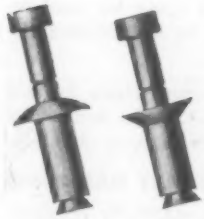

For specific information about the proper Cherry Rivet for your work, write us or fill out the coupon below.

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AIR TRANSPORT

Revolt of the Pilots—IV

New ALPA to Press Mileage Issue

Attempt to make distance flown the basis of monthly wage is tied to alleged fatigue factor of faster planes.

By William Kroger

A new factor, mileage increase determination, is revising all former concepts of an airline pilot's working conditions, and this one issue will dominate negotiations between airline management and the Air Line Pilots Assn. for years to come.

Management, while it may rebel at the injection of this issue into its contract bargaining, might as well prepare to face it; even before they complete the reorganization of ALPA (AVIATION WEEK, Aug. 20, p. 63), President Clarence N. Sayen and his associates will be insisting upon recognition of the mileage increase determination principle.

▶**The Formula**—Mileage increase determination, as Sayen explains it, is a scientific formula for determining pay on the basis of the number of miles flown each month, and increasing the basic number of miles flown with use of faster aircraft. To the airlines, it is a method to limit the number of miles they can fly each month.

The only limitation at present on the use of a pilot is that he cannot fly more than eight hours a day and more than 85 hours a month. To the airlines, that means he should fly 85 hours a month. To the pilots that is a maximum set in other, less strenuous days.

The issue came up in the American Airlines' Presidential emergency board hearings, and Sayen says that in the discussion of a possible future 1,000-mph. jet airplane, the pilots offered to fly such a plane 51,000 mi. a month. American, however, said that as a pilot should fly 85 hours a month, a 1,000-mph. airplane should be flown 85,000 mi a month.

That is the difference between the pilots and one airline. For another view, United Air Lines' W. A. Patterson rejects the mileage increase determination proposal because, he says, pilots will have a right to be concerned about jet and turboprop planes when they arrive. "How can we be intelligent about a problem we don't understand yet?" he asks. "We can't settle tomorrow's problems today."

Such a dismissal of the issue is more irritating to the pilots than an economic argument against the formula. For one of their texts is Decision 83 of the National Labor Board (predecessor of National Labor Relations Board), and one sentence in that document reads:

"Experience has not crystallized sufficiently to put a maximum on the monthly mileage of air pilots."

That opinion was rendered 17 years ago. Pilots say the time now has come to draw on the past experience of introduction of new equipment and set rules for the future.

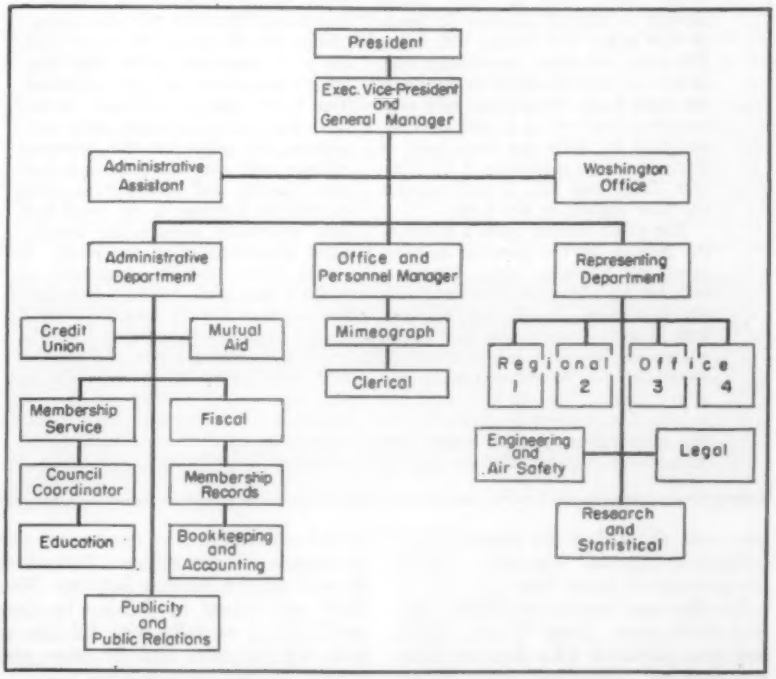
It was Decision 83 that fixed the 85-hr. limitation that the pilots now are trying to shelve. It also laid down the fundamental arguments the pilots now use in seeking mileage increase determination (see box on next page).

▶**Featherbed or Fatigue?**—The airlines, naturally, want 85 hours a month to be the basic working condition for pilots. If a pilot flies 85 hours a month on large, fast airplanes, the airlines are pulling in more revenue from that pilot's labor. And, the carriers claim, that's the way it should be to take best advantage of technological improvements. In return, they are willing to pay that pilot more, enabling him to share in the greater productivity. The carriers say this involves a risk on their part; the airplane he is flying is a far more costly piece of equipment than it used to be.

The pilots' attempt to make miles flown a month the basic working condition, says management, is an attempt to interfere with technological progress. It is "featherbedding," the curse of the railroads; and airline management is

Special Report

What's behind the change in leadership of the Air Line Pilots Assn., and what does it mean? The airline industry and organized labor have been studying that question ever since early one July morning when David L. Behncke found he had been "recalled" from his presidency of the union. For answers AVIATION WEEK *sent a staff member to Chicago where he talked at length with ALPA's officials and employes, and obtained the only exclusive interview Behncke has granted on the intra-union dispute. The result is a special report, in four weekly installments which began Aug. 6, the last of which appears on these pages.*



THE NEW ALPA: When three roofs become one, working conditions will improve.

Decision 83

Following is the complete text of the decision rendered May 10, 1934 by the National Labor Board that set the existing working conditions for airline pilots, and also planted the seed that has flowered into "mileage increase determination." Although the conditions set forth by the decision were to exist for only one year, the Civil Aeronautics Act specifies that the terms of Decision 83 have to be observed by the carriers.

The Air Line Pilots' Association and American Airways, Eastern Air Transport, Transcontinental and Western Air, United Air Lines, and Western Air Express jointly submitted to the National Labor Board, in September 1933, a wage dispute concerning the rate and method of payment for air pilots. The National Labor Board referred the matter to a fact-finding committee for study and recommendation and caused a detailed study of the wage situation in this industry to be made. The Board's decision had been withheld for several months because of the uncertain conditions in the industry resulting from the cancellation of the air-mail contracts in February. In view of the recent changes in the industry, the Board feels that a public service will be rendered by the issuance of a decision setting forth its views regarding a fair wage scale for air pilots.

The traditional method of computing pilots' wages on the basis of mileage flown was abandoned by the industry during the period from 1931 to 1933. The dispute was occasioned by the new rates which had been put into effect on October 1, 1933, by all the companies involved. These rates are on an hourly basis and provide for $4 an hour for day flying under 125 miles hourly speed, with 20 cents hourly increase to become effective at speeds of 126 miles, 141 miles, 156 miles, 176 miles, 201 miles, respectively. Two dollars an hour is added to each rate for night flying. In addition each pilot receives a base rate of $1,600 annually, increased by $200 for each year of service, up to a maximum of $3,000 a year. This base rate is paid whether the pilot engages in any flying.

The pilots insisted upon a return to the mileage basis of payment and proposed the following scale: 4 cents a mile for day flying and 7 cents a mile for night flying. In addition each pilot with an increase to 5 cents and 9 cents a day for day and night flying, respectively, over hazardous terrain, plus a base rate of from $1,800 to $3,000 a year. The companies contended for the continuation of the October first rates. These rates provided for approximately the same compensation for all flights at the low rates of speed which had been customary in the past, but resulted in materially reduced compensation for flights at the increased speeds which the industry has been striving to introduce and attain.

The October rates are inadequate for additional reasons. The differential paid for night flying as against day flying seems insufficient, the speeds at which the increased hourly rates would become effective seem impracticable, and the differential for the increased speeds does not sufficiently take into account the increased hazards and the probable increased earnings to be derived from the speedier equipment.

The industry is on the threshold of technological improvement which will greatly accelerate the speed of airplane travel and which may result in some technological unemployment. The increase of speed will either greatly increase the mileage covered by the pilots or materially reduce their monthly hours of employment. If the pilots were to fly in the future the same number of hours as in the past and were paid on the same monthly basis, their monthly earnings would be greatly increased. Similarly, were the mileage basis to be continued and the hours of actual flying reduced, there would be no change in monthly earnings notwithstanding the sharp reduction in monthly hours. In either event, the pilot would receive the chief benefits accruing from the new equipment. The hourly basis of payment, on the other hand, does not adequately compensate the pilots for the increased mileage with the added hazards incident thereto, and results in a sharp decrease of earnings in the event that new equipment reduces the employment opportunities of the pilots. It would seem advisable, therefore, to adopt a basis of pay under which both the company and the employees would share in the benefit accruing from the new equipment and bear the burdens that will attend its introduction in the beginning. Various bases of compensation were accordingly studied that mately the same compensation for all promised to attain this objective and a combination of both methods of payment was devised. The Board's report summarizing these studies was submitted to the parties for their criticism and suggestions. It thus appears that the method of payments recommended by the Board will impose no undue burdens upon the companies, that it can be administered without any practical difficulties, and that it provides an adequate basis of compensation for the pilots.

As the issues have been fully discussed with the parties and the considerations impelling the Board in reaching this decision have been outlined in an elaborate report, it is unnecessary to describe the issues here involved in any detail. In the attached chart the various methods of payment proposed by the parties and the Board are tabulated.

It is the decision of the National Labor Board on all the issues submitted that:

1. Eighty-five hours of flying shall constitute the monthly maximum for air pilots.

2. Experience has not crystallized sufficiently to put a maximum on the monthly mileage of air pilots.

3. The rate of base pay shall be $1,600 a year with an increase of $200 for each year of service up to a maximum of $3,000.

4. Air-line pilots shall be paid the base rate plus an hourly rate of $4, $4.20, $4.40, $4.60, $4.80, and $5 for day flying and $6, $6.30, $6.60, $6.90, and $7.20, and $7.50 for night flying at hourly speeds of under 125 miles, 125 miles, 140 miles, 155 miles, 175 miles, and 200 or more miles, respectively. In addition, at monthly mileages of under 10,000, 10,000 to 11,999 miles, and 12,000 miles and more, respectively, the pilots shall be paid 2 cents, 1½ cents, and 1 cent a mile for all miles per hour flown at an hourly speed of more than 100 miles.

5. This award shall remain in effect for a period of one year.

6. The differentials existing on October 1, 1933, for copilots and for flying over hazardous terrain shall be maintained.

genuinely alarmed at the prospect that featherbedding will similarly stultify the progress of the airlines.

To the new leaders of ALPA, this is a straw man. Jerry Wood, ALPA first vice president who flies for Eastern, explains: "We don't want featherbedding. We know what it has done to the railroads, and we don't want that to happen to the airlines. I used to fly five trips a month between New York and Miami in DC-3s. In Constellations, I now fly ten. I'd like to split the difference and fly seven and a half. Is that unreasonable?"

It is true, of course, that a pilot on that kind of schedule would make more money with ten trips on the present basis of payment, because to get his maximum pay he must be at the controls 85 hours a month. And it is true that if Wood made only seven and one-half trips a month Eastern would have to hire additional pilots in order to hold

up their schedules. The pilots think that is entirely justified.

They agree with the carriers that they now fly a far more costly airplane. But, they say, it is also a more complicated airplane. And, because it is also faster, they can make more trips a month. That means more landings and takeoffs, more instrument approaches—the big fatigue-producing factors. This is a very real thing to a pilot.

A visitor to ALPA's Chicago headquarters was talking to a pilot who is assigned to a certain twin-engine aircraft with a notable safety record. The visitor commented that he liked that airplane; it has so much power for its gross weight that it is the only airplane he always feels certain will take off when it starts down the runway.

The pilot looked at him in amazement. "You do? I wish I did!"

▶**Ceiling Meets Floor**—The airplanes have changed, say the pilots, but the working conditions, set in 1934 by Decision 83, have not. The 85 hours was supposed to be a maximum. In actual practice, it also has become a minimum.

ALPA officials smile wryly over an incident that happened recently to three co-pilots of one of the Big Four airlines. Each had 84 hours time that month. So they were all put on one trip of three hours' duration and took turns in the right-hand seat.

A company defense of that action probably would be that the pilots wouldn't get a full month's pay without that last hour. But ALPA's attitude is that it shouldn't be necessary to squeeze the last bit of monthly usefulness out of a pilot for him to be properly compensated.

However individual pilots may feel, the ALPA executives are not interested in greater pay for pilots, except as a by-product of other benefits. Present pay is an irritant, of course, because the pilots claim that on a mileage basis, pilots now are being paid less than ever before—a natural economic development with the greater mileage productivity of the airplanes.

If the airlines want to pay pilots more than they now are getting, that is satisfactory to Sayen—but he wants it to be penalty payment. That stems from the mileage increase determination concept.

Assume that ALPA were successful in obtaining agreement that pay for flying the DC-6B should be based on 17,500 miles a month. (That, incidentally, was a discussion figure and not a final demand.) To fly 17,500 miles a month in a DC-6B, the pilot would have to fly about 70 hours. He would get his maximum pay for that much time. If the airline wanted him to fly 85 hours a month, ALPA would have no objection—provided he were paid at a higher rate, say one and one-half times base pay. Sayen's idea is to make it too expensive for an airline to use a pilot 85 hours a month. He believes an airline doesn't get full value from a pilot in that last 10 or 15 hours. The reason again is fatigue.

▶**14-Hour Day**—While the greater number of trips, with more takeoffs and landings, is perhaps the most important fatigue factor, ranking right up with it is "on-duty time."

To fly 85 hours a month, the average pilot is "on-duty (subject to call) 16 hours a day, ALPA claims. He may fly a four-hour trip out and four hours back to use up his eight hours, but in between he may lay over as long as eight hours either because of scheduling or weather. The pilots claim that during that eight hours their time belongs to the company. If the return trip is delayed by weather, for example, the pilot must stay at the field and cannot even go into town for relaxation. So the pilots want on-duty time limited, with some form of overtime payment when it is necessary to exceed the limit.

Thinking of the industrial norm of a seven- or eight-hour day, Sayen smiles innocently as he says. "We're asking a 14-hour day. That's not too much for 1951, is it?"

The airlines ridicule on-duty time as an issue. United's Patterson says the pilots want to be paid for time spent in hotels. United and other carriers are willing to pay extra if a pilot has to spend long hours at a field waiting to take his trip out. But when a pilot lays over five or six hours and goes into town to a hotel, the carriers balk at considering that "working."

United says its captains have 12 full 24-hour days off at home each month. In addition, they have the major portion of five other days at home. Senior pilots on UAL's Chicago-New York run spend every night at home, the carrier says. But when a pilot is away from his base, UAL allows him $7.85 per day for meals and lodging, plus expenses for ground transportation. A typical time allowance for a pilot on the Chicago-New York run, UAL says, is this:

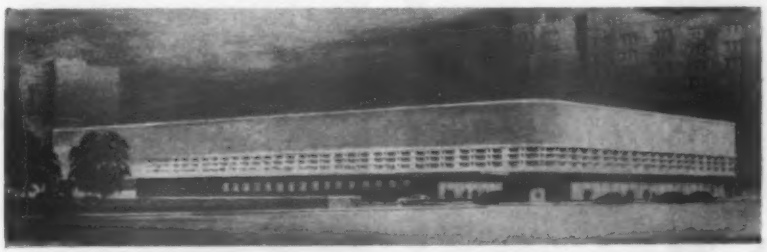
Check-in prior to flight	1:00
Flight to N. Y.	2:55
N. Y. layover	2:35
Flight to Chicago	3:24
Check-out at Chicago	0:30
TOTAL	10:24

After working that schedule three successive days, pilots have four days off.

ALPA's retort would be that the above is an "ideal" schedule, and that the Chicago-New York route is only one of many. On the New York-Washington run, for instance, conditions would be different. There, with a flight time of only 50-60 minutes, a pilot could make four roundtrips a day and not exceed his eight flying hours, but still be on duty 16 or more hours. Actually, that has happened more than once. To increase the fatigue, a pilot on the New York-Washington route, with stops at Philadelphia and Baltimore, has been known to make 13 instrument approaches in one day.

▶**Full House**—Those are the things that Clancy Sayen, not too many years removed from piloting himself, contemplates as he swivels around from his desk in a tiny room above a real estate office and looks out over the grubby back yards of Chicago's South Side. In a way, ALPA's headquarters are symbolic of what Sayen thinks has been the progress of the association in 20 years, and of what Sayen thinks is the pilots' present position.

The Air Line Pilots Assn. is a large organization, with about 70 fulltime employes. But they are scattered. The "President's Department" is above the real estate office on 63rd Street, a few doors from Kedzie Ave., a good five miles from the Loop. Sayen is still oc-



SWANK AIRLINES TERMINAL

Scheduled for completion in less than two years, this imposing $5.5-million airlines terminal building is planned for lower Manhattan, New York. It will have provision for a heliport. Tenants will be 21 scheduled and nonscheduled airlines, including 11 foreign air carriers. Passenger lobby will cover more than 25,000 sq. ft. Paul H. Brattain, first vice president of Eastern Air Lines, has been made president of the terminal corporation. The new facility is deemed necessary because the city's present airlines terminal can only take care of the needs of six airlines.

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cupying the same office in the back of the building, he used as executive vice president, because Behncke has not relinquished the key to the president's office.

Diagonally across the street, above a hardware store, is the "Administrative Department," which embraces council coordination, engineering, employment agreements, accounting, grievance and conciliation, education, legal and pension. On the same side of the street, a few doors nearer Kedzie Ave. and above a five-and-ten-cent store is the publicity department and the offices of the affiliate unions.

The three walk-up offices are fully staffed and equipped, but they are so greatly overcrowded and communication between them is so necessarily inconvenient that work is hampered. The headquarters has outgrown its surroundings.

Similarly, ALPA has members well-equipped to handle intelligently all the problems confronting pilots today; but in the past their work, and communication among them has been hampered by the organization of the association, with one man trying to carry the entire load. And in Sayen's view, the pilots out on the line also have out-grown their surroundings—Decision 83.

ALPA's own working conditions will be improved when the new headquarters building is ready, probably late this year or early next year. To Sayen and his colleagues, the pilots' working conditions will not be improved until mileage increase determination is no longer an issue but a rule that pilots fly by.

ATA Studies Pool of Carrier Spare Parts

Members of Air Transport Assn. are making preliminary reports to ATA on whether they want a cooperative pool of low-turnover inventory items—so-called "insurance" items.

The idea of maintenance supply pooling by the airlines has been sparked by ATA's Edward Kelly and by Capital Airlines and Pan American World Airways.

Preliminary survey the airlines are now working on would list all "insurance"-type maintenance and repair items worth $500 or more for postwar type transports. Survey will show how many units are available, their unit value, whether or not they are practical for pooling with other airlines, and whether an item is so modified by one airline that others couldn't pick it up from the parts pool. All engine parts and assemblies are excluded, because turnover is too active to make pooling of these practical.

Airlines are turning in individual reports to Kelly, executive secretary of the ATA Airline Finance and Accounting Conference.

The survey will show if there are

AIRLINER AMBULANCE

Stretcher kit for carrying patients aboard Chicago & Southern Air Lines' Constellations takes up three seats, with fourth being used by nurse. Foam rubber bed has been shaped to fit seat area. Airline provides all linens but arrangements for ambulance service at terminal points must be made by the passenger. C&S has used the facility for flying a number of stretcher cases to medical centers. When not in use the bed is carried in the Connie's belly compartment.

enough "insurance items" carried by each airline to justify pooling. If the airlines decide there are, they plan to set up some for a regional warehousing cooperative. For example, United might stock little-used spares for airlines with routes in the Chicago area, Eastern in the Miami area, TWA around Kansas City, Capital in Washington.

Research on the project is handled by the ATA stocks and stores subcommittee, in collaboration with airline purchasing departments.

The idea has been discussed for years. Recent rapid growth in value, complexity and variety of airlines' investment in spare parts on hand and on order gave the airlines a final push to decide now whether or not pooling will save money on both inventory outlay and operating efficiency.

Some airlines have been skeptical about the system. They say that when an airline wants a part, it is wanted right away, and airlines modify many parts to suit their own preferences, thus making them non-standard.

PAA Liberia Crash Cause Still Unknown

Pan American World Airways has not reached any conclusion as to the probable cause of the Constellation crash in Liberia last June which killed all 31 passengers and crew of nine.

PAA Atlantic division manager Horace Brock, said at the recent Civil Aeronautics Board accident hearings that the plane was "properly cleared maintenance-wise"; pilot, Captain Frank Crawford, had 7,817 flying hours and had made previous trips over the fatal route; plane had eight hours reserve fuel when it crashed.

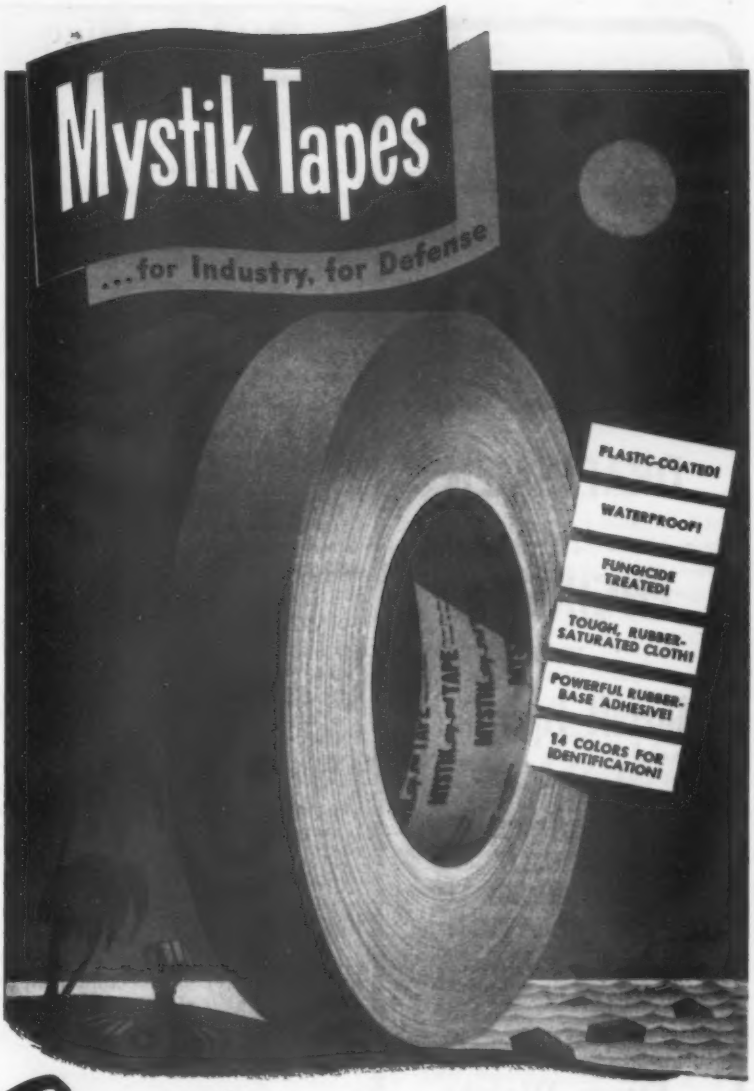
PanAm had operated in Africa for ten years without a death or injury, and had operated around the world for over three years without fatality.

New York-Havana Permit to Cubana

The Civil Aeronautics Board in a 5-to-0 decision, has given a Havana-New York air carrier permit for three years to Compania Cubana de Aviacion.

Cubana is part owned by Pan American World Airways. It will compete with National and Eastern. So CAB insists, in granting the permit, that PanAm and Cubana shall not reveal their relationship in publicity or help each other in sales. PanAm is also to continue divesting itself of its 42% stockholding in Cubana.

CAB Examiner J. Earl Cox had recommended Cubana for a 5-year permit, over the other two applicants—Aerovias "Q" and Expreso Aereo Inter-Americano.



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SHORTLINES

► **Air Transport Assn.**—ATA Counsel Stuart G. Tipton asks the House Ways and Means Committee, considering the customs simplification act (H.R.1535), to allow "informal entry" of goods valued under $500, goods on the free list not subject to customs, and let air carrier make informal entry on behalf of their consignees. Air arrivals in this country subject to customs inspection numbered 580,609 passengers last year, he notes.

► **Colonial Airlines**—Colonial carried a record 28,050 passengers in July; domestic passenger miles gained 20% over a year ago to 5,892,398, mostly due to increased DC-3 seat capacity from 21 to 26.

► **Mid-Continent Airlines**—MCA earned a net profit of $133,600 or 32 cents a share the first half of this year on its trunk routes, compared with $154,284 a year ago. A reported net loss of $48,424 on its local service route, after allowance for tax saving attributable to the loss, reduced the company's net profit to $85,176 or 20 cents a share. MCA says revised mail rates on the local routes will much improve the line's reported earnings and finances.

► **Pan American World Airways**—A PanAm spokesman says carrier is not worried about coming competition from the jet Comets of British Overseas Airways. PanAm will buy Comets, too, if needed.

► **Pioneer Air Lines**—Pioneer has resumed service to Mineral Wells, Tex., following improvements to taxi-ways. CAA inspectors closed the field July 3 until it should be improved. . . . Pioneer asks CAB for nonstop service, Abilene-Austin, service to Monahans from Midland-Odessa, and permission to serve Brownwood as alternate point between Abilene and Austin.

► **Sabena**—Belgian airline plans service, New York-Cologne-Stuttgart; also Barcelona starting October.

► **Transocean Air Lines**—Transocean has started scheduled service on its U. S. government contract to serve the trust territory of the Pacific Islands. Contract is effective through June 30, with options to the government to renew through 1956. Transocean is giving similar service along the Aleutian Islands chain under Navy contract.

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AVIATION CALENDAR

Sept. 3-7—Royal Aeronautical Society-IAS third international aeronautical conference, Brighton, Sussex, England.

Sept. 10-14—Sixth national instrument conference and exhibit sponsored by the Instrument Society of America, Sam Houston Coliseum, Houston, Tex.

Sept. 10-16—Seventh annual general meeting of the International Air Transport Assn., Westminster School, London, England. Program includes one-day visit to SBAC Farnborough show.

Sept. 11-16—Twelfth flying display and exhibition of the Society of British Aircraft Constructors, Farnborough, England.

Sept. 15—Air tour to Nantucket Island, Mass., sponsored by the Nantucket Flying Club, Nantucket Memorial Airport, Mass.

Sept. 17-19—15th annual convention of the International Northwest Aviation Council, Jasper National Park, Alberta, Canada.

Sept. 18-20—Meeting of the meteorology committee of the Air Transport Assn., Greystone Lodge, Denver.

Sept. 20—Aviation Writers Assn. luncheon, with featured guest speakers, Wings Club, Hotel Biltmore, N. Y. C.

Sept. 26-28—Fall meeting of the American Society of Mechanical Engineers, Hotel Radisson, Minneapolis.

Oct. 2-4—Seventh annual aircraft spark plug and ignition conference sponsored by the Champion Spark Plug Co. of Toledo.

Oct. 3-6—Annual national aeronautical and engineering display and aircraft production forum, sponsored by Society of Automotive Engineers, Biltmore Hotel, Los Angeles.

Oct. 8-10—Special conference on aircraft electrical applications, sponsored by the Air transportation committee of the American Institute of Electrical Engineers and the Los Angeles section of the Institute, Hollywood Roosevelt Hotel, Hollywood.

Oct. 11-12—1951 conference on airport management and operation, University of Oklahoma, Norman, Okla.

Oct. 16-17—Fourth annual New York State conference on airport development and operations, sponsored by the N. Y. State Dept. of Commerce, N. Y. Aviation Trades Assn., Assn. of Towns of the State, Conference of Mayors, County Officers' Assn. and the N. Y. State Flying Farmers, Onondaga Hotel, Syracuse, N. Y.

Oct. 20-30—Air Industry & Transport Assn. of Canada annual general meeting, Seigniory Club, Montebello, Quebec.

Oct. 24-25—1951 annual convention of the National Assn. of State Aviation Officials, Arizona Inn, Tucson, Ariz.

Oct. 31-Nov. 1—Society of Automatic Engineers, fuels and lubricants meeting, Drake Hotel, Chicago.

Nov. 7—Annual Wings Club Dinner, Waldorf-Astoria, New York.

PICTURE CREDITS

8—(top) British Information Services; (center, lower right) Howard Levy; (lower left) Wide World; 13—(left) Acme; (right) Wide World; 15—L. Booda; 16—Edgar Deigan; 18—Boeing.

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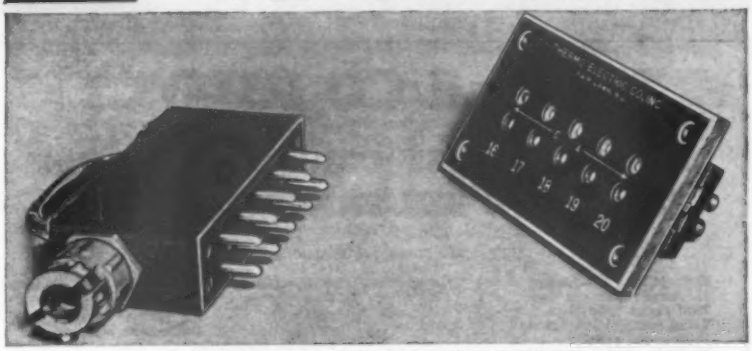

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(Continued on page 72)

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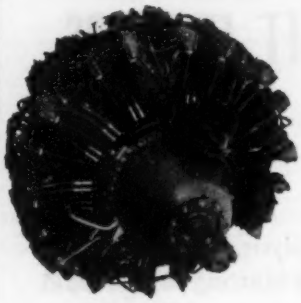

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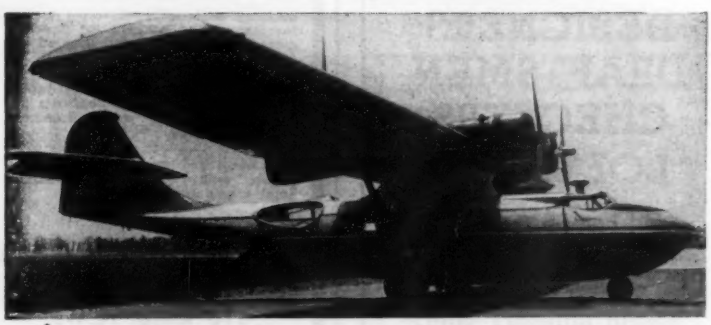

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1475	48360	Bearing
53	48362	Shaft
175	48363	Shaft
100	48389	Fitting
209	48390	Retainer
56	48392	Sump
533	48447	Bushing
107	48457	Adapter
390	48461	Gear
149	48468	Bearing
90	48468B	Bearing
389	48469	Bearing
470	48478	Bearing
75000	51586	Plug
395	54847	Clamp
71	57006	Cover
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565	81397	Tube
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9000	45	Bulb
11000	1667	Bulb
1000	987	Bulb
300	AN3135-1	Bulb
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29	FT293	Mount
80	BX42-7	Dynamotor
6	RTA-1P	Transceiver

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22	982512 Cylinder CO^2 w/valve Wt. Empty 11.65 lbs. Wt. of Charge 7.25 lbs. Valve number 979453 J
96	992255 Cylinder CO^2 (type 5A-hand fire extinguisher) Full wt 14.3 lbs.
93	923748 Oxygen cylinder (full) w/valve #X4015 Charges to 1800 PSI
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326	982585 Gate Valve with 1-1/4" Flare tube threads

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160	2E-492E	Pesco fuel pumps
700	TFD 8600	Thompson fuel booster pump
125	D-7818	Adel anti-icer pumps
170	2-P-771-A	Pesco fuel pump AN4102-1
250	AN4014	Erie Meter Systems D-3 hand wobble pump
300	1H260k and KA	Pesco Hydraulic hand pump
478	D9530	Adel selector valve
233	D9530-2	Adel selector valve
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175	EE 709-M2	Air Associates Motor
115	P4CA2A	Parker Primers
80	AN 3213-1	Scintilla Ignition switch
568	A-9 (94-32226)	Ignition switch
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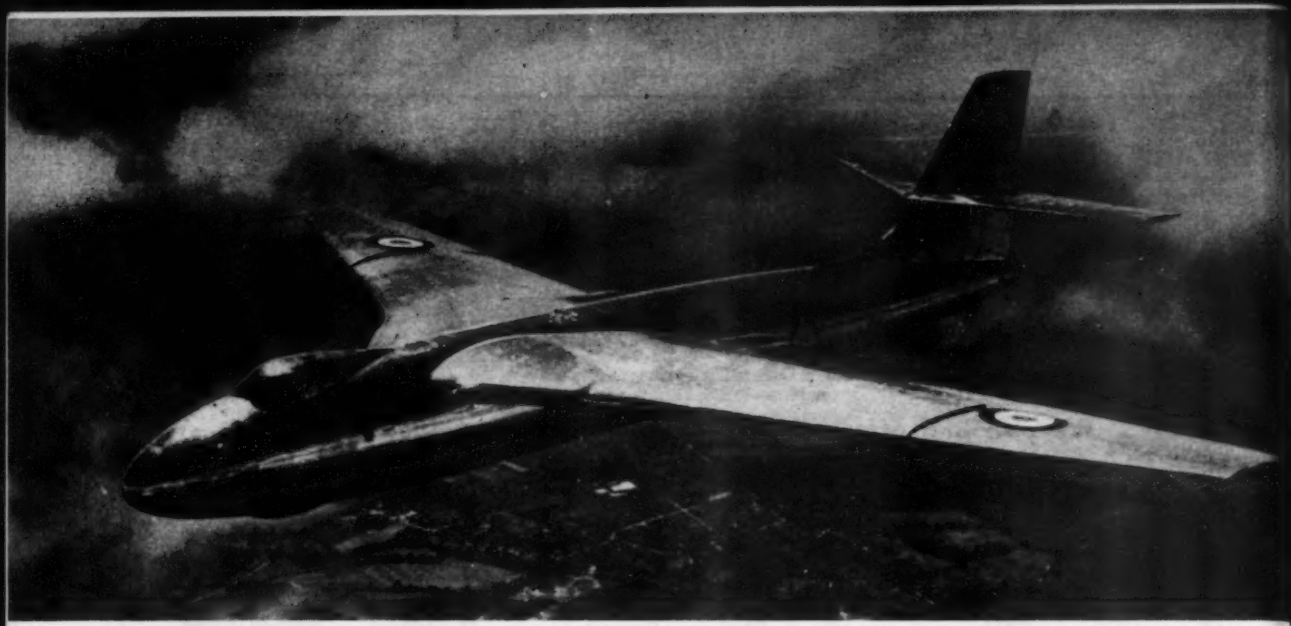
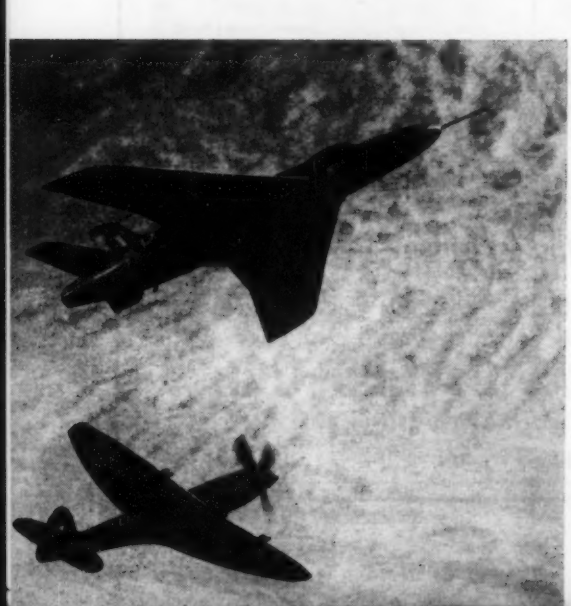


VALIANT ALOFT—Sleek, new Vickers 660 Valiant four-jet (Rolls-Royce Avon) sweptwing bomber is seen in flight for the first time, emphasizing the big craft's extremely fine lines. RAF has ordered an unknown but "substantial" quantity of the new plane.

Foreign Aircraft Picture Highlights

VARIATIONS ON A THEME—The Breguet 892-S Mercure (above, left) is a four-engine (500-hp. SNECMA Argus) development of the twin-engine 890-H (1,565-hp. Bristol Hercules). The former is a light cargo transport, the latter (right) can seat 40 passengers.



ON WITH THE NEW—First British sweptwing fighter to go into production f RAF, the new Supermarine Swift (Rolls-Royce Avon) is pictured above and ab the older piston-engine Spitfire, which long epitomized Britain's fighter power.

FRENCH HEAVYWEIGHT—Breguet 763 Deux Ponts (two decks) transport, can carry up to 130 passengers, sits on the tarmac with its very large cargo l doors open. The 763 is powered by four P&W R-2800s of 1800 hp. each. A ber of these planes have been ordered by Air France as freighters.

ADVERTISERS IN THIS ISSUE

AVIATION WEEK—AUGUST 27, 1951

AIRBORNE ACCESSORIES CORP. 10
Agency—Gray & Rogers Adv.

ALLISON DIVISION OF GENERAL MOTORS ..... Fourth Cover
Agency—Kudner Agency, Inc.

AVIATION ACCESSORIES, INC. 9
Agency—Kimball Adv. Agency

AVICA CORPORATION 48
Agency—Knight & Gilbert, Inc.

BEECH AIRCRAFT CORP. 46
Agency—Erwin, Wasey & Co., Inc.

B. H. AIRCRAFT CO., INC. 34
Agency—Harold Marshall Adv. Co.

CHERRY RIVET COMPANY 61
Agency—Hixon & Jorgensen, Inc.

CHEVROLET MOTOR DIV. OF GENERAL MOTORS 58
Agency—Campbell-Ewald Co.

CHICAGO METAL HOSE CORP. 5
Agency—Russell T. Gray, Inc.

CITIES SERVICE OIL CO. 31
Agency—Ellington & Co., Inc.

CLIFFORD MANUFACTURING COMPANY 42
Agency—James Thomas Chirurg Co.

CONSOLIDATED VULTEE AIRCRAFT CORP. 53
Agency—Buchanan & Co., Inc.

CONTINENTAL MOTORS CORP. 28
Agency—Cummings & Hopkins Adv.

CROUSE-HINDS COMPANY 40, 41
Agency—Barlow Advertising Agency

DARNELL CORPORATION, LTD. 66
Agency—Rhea Advertising Service

ELECTRICAL ENGINEERING & MFG. CORP ..... Third Cover
Agency—West-Marquis, Inc.

ELECTRIC AUTO-LITE CO., THE 35
Agency—Ruthrauff & Ryan, Inc.

FAIRCHILD ENGINE & AIRPLANE CORPORATION 22
Agency—Buchanan & Co., Inc.

FLIGHT REFUELING, INCORPORATED 36
Agency—Corydon M. Johnson Co., Inc.

FLYING TIGER LINE, INC. 33
Agency—Heintz & Co., Inc.

GENERAL ELECTRIC COMPANY 6, 7
Agency—G. M. Basford Co.

GOODRICH CO., THE B. F. 3
Agency—Batten, Barton, Durstine & Osborn, Inc.

HI-SHEAR RIVET TOOL CO., THE 57
Agency—John T. Hales Co.

HYDRO-AIRE, INC. ..... Second Cover
Agency—John H. Riordan Co.

JACK & HEINTZ, INC. 49
Agency—Fuller & Smith & Ross, Inc.

LAMSON & SESSIONS CO., THE 26
Agency—Belden & Hickox Adv.

LEWIS ENGINEERING CO., THE 43

LINE MATERIAL COMPANY 39
Agency—Erwin, Wasey & Co., Ltd.

MARMAN PRODUCTS CO., INC. 37
Agency—West-Marquis, Inc.

McGRAW-HILL BOOK CO., INC. 77

MINNEAPOLIS-HONEYWELL REGULATOR CO. ..... Front Cover
Agency—Foote, Cone & Belding

MYSTIK ADHESIVE PRODUCTS 67
Agency—George H. Hartman Co.

NORTH AMERICAN AVIATION, INC. 68
Agency—Batten, Barton, Durstine & Osborn, Inc.

OHIO SEAMLESS TUBE CO., THE 32
Agency—Howard Swink Adv. Agency, Inc.

PIASECKI HELICOPTER CORP. 63
Agency—B. K. Davis & Bro.

RADIO APPARATUS CORP. 54
Agency—Burton Browne Adv.

ROEBLING'S SONS CO., JOHN A. 4
Agency—Beatty & Oliver, Inc.

ROHR AIRCRAFT CORP. 55
Agency—Barnes Chase Co.

RYERSON & SON, INC., JOSEPH T. 27
Agency—Aubrey, Moore & Wallace Adv.

SAGINAW STEERING GEAR DIV. OF GENERAL MOTORS 24
Agency—Campbell-Ewald Co.

SCINTILLA MAGNETO DIV. OF BENDIX AVIATION CORP. 45
Agency—MacManus, John & Adams, Inc.

SCOVILL MANUFACTURING CO. 21
Agency—The Schuyler Hopper Co.

SEARCHLIGHT SECTION 70, 71, 72, 73, 74, 75

SENSENICH CORPORATION 60
Agency—Foltz-Wessinger, Inc.

SHELL OIL COMPANY 50
Agency—J. Walter Thompson Co.

SOCONY-VACUUM OIL CO., INC. 25
Agency—Compton Adv., Inc.

STANDARD PRESSED STEEL CO. 52
Agency—R. E. Lovekin Corp.

TEXAS COMPANY, THE 9
Agency—Erwin, Wasey & Co., Inc.

THERMO ELECTRIC COMPANY 59
Agency—Fred Lange Associates, Inc.

UNITED AIRCRAFT CORP. 56
Agency—Geyer, Newell & Ganger, Inc.

WESTINGHOUSE AIR BRAKE CO. 47
Agency—Ketchum, MacLeod & Grove, Inc.

WESTINGHOUSE ELECTRIC CORP. 12
Agency—Fuller & Smith & Ross, Inc.

WIGGINS OIL TOOL CO., INC., E. B. 54
Agency—Welsh-Hollander Adv.

WILCOX ELECTRIC COMPANY 62
Agency—Arthur G. Rippey & Co.

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT
Positions Vacant 70, 71, 72, 73
Positions Wanted 70, 72
Selling Opportunities Wanted 70, 72

SPECIAL SERVICES 72
Contract Work 72

EDUCATIONAL
Schools 73

EQUIPMENT
(Used or Surplus New)
For Sale 72, 74, 75

WANTED
Equipment 72

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LETTERS

Flammable Fluids

We were most interested in the July 16 AVIATION WEEK and the article on our H-2 non-flammable hydraulic fluid. We have already had many comments and inquiries regarding our fluid, as a result of this publicity, and we look forward to receiving many more.

We have always felt that your magazine is the leading publication in its field, and we were extremely pleased with the excellent presentation of the facts concerning our product. Mr. George Christian is to be complimented for having done what we consider an outstanding job.

FREDERICK H. LEE, JR.
Sales Manager
Industrial-Aviation Div.
R. M. Hollingshead Corp.
Camden 2, N. J.

It was with considerable surprise that we read the title of the article "The Hydraulic Fluid That Will NOT Burn" on page 54 of AVIATION WEEK for July 16, 1951. We feel that this is a very misleading statement and can do a great deal of harm by implying that there are aviation hydraulic fluids that will not burn under any conditions.

Without attempting to pass on the usefulness of H-2, we would like to point out that it does have a flash point of 290 degrees F. and a fire point of 295 degrees F. by the Cleveland Open Cup Method. These results were obtained at an independent laboratory and are quite at variance with the statement in your article, "practically speaking, the fluid has no flash point."

We feel that you would have been better advised to have referred to the fluid as a "non-flammable type" hydraulic fluid and that such a reference would be much less misleading.

J. KENNETH CRAVER,
Manager Functional Fluids
Development Dept.
Organic Chemicals Div.
Monsanto Chemical Co.
St. Louis 4.

CC: DR. VITO ESPOSITO
R. M. Hollingshead Corp.
Camden, N. J.

Dr. V. Esposito of our Research Division has received a copy of a letter to you from Mr. J. K. Craver of the Monsanto Chemical Co., in which he . . . (says) that our H-2 hydraulic fluid is not non-flammable. He (points out) . . . that H-2 has a flash-point of 290 degrees F., and a fire-point of 295 degrees F., by the Cleveland Open Cup Method.

As anyone familiar with the Cleveland Open Cup Method knows, it was developed and is used as a means of determining the flash-points of various petroleum products, so that they may be compared. H-2 is not a petroleum product, and it therefore logically follows that this test method would not be suitable, and should not be used in determining the non-flammability of such a synthetic fluid, or any other synthetic type hydraulic fluid. Instead, a universal flammability test should be used, which will apply to all fluids, regardless of type. This fact has been recognized by the Civil Aeronautics Administration, and they have expressed the same opinion in the "Conclusions" section of their Technical Development Report No. 142 titled, "Determination of Ignition Characteristics of Hydraulic fluids Part II Flammability Reference Scale."

Until March of 1949, the various manufacturers competing in the development of non-flammable and non-flammable type hydraulic fluids devised their own methods for determining the flammability of their products, and quite naturally were pleased if the particular tests they developed proved that a competitor's product was inferior. At that time the CAA decided that the evaluation of non-flammable hydraulic fluids warranted some investigation on their part, and the CAA Technical Development and Evaluation Center at Indianapolis began an investigation to arrive at a suitable means for evaluating the various fluids available, as to their degree of non-flammability.

In April of 1951, they issued their report No. 64 titled, "Determination of Ignition Characteristics of Hydraulic Fluids Part I Simulated Flight and Crash Condition." In the conclusions of that report they stated that a standardized procedure for testing and determining the relative ignitability of hydraulic fluids was apparently possible and would be desirable.

Part II of the report was issued in May of 1951 and covers the method they have developed for rating fluids, by introducing a sufficient amount of hexachlorobutadiene into any given fluid to make it non-flammable. By use of this rating method, H-2 is the only presently available hydraulic fluid which carries a Flammability Reference Scale rating of O. In other words, it is the only fluid which does not require the introduction of any hexachlorobutadiene to make it non-flammable.

The R. M. Hollingshead Corp. has never claimed that all constituents of H-2 are non-flammable. By use of the Cleveland Open Cup test the water content of H-2 is driven off by continued application of heat. In the absence of water, the ethylene glycol constituent of H-2 will vaporize and flash at 295 degrees F. Inasmuch as such a set of conditions is never encountered in an airplane hydraulic system or in an aircraft fire, we do not feel such a test is pertinent in evaluating our fluid as to its non-flammability. A laboratory test should simulate service conditions, and in an airplane hydraulic system which ruptures or develops a leak in some way, the hydraulic fluid as an entity is sprayed on to a hot manifold or is subjected to an arc of flame in producing a fire hazard. The fluid is not first broken down by boiling or heating for an extended period of time.

When H-2 is considered as a complete hydraulic fluid, it will not burn. This has been conclusively proven in accidents involving Naval aircraft wherein airplanes and lives have been saved because the airplane was equipped with ethylene glycol-water base fluids rather than petroleum fluids.

In view of the above, we feel that we are fully justified in classifying the H-2 as a truly non-flammable fluid and in stating that it will not burn, and we shall continue to do so.

W. V. SCHOLZ,
Technical Representative
Hydraulic Section
Industrial-Aviation Division
R. M. Hollingshead Corp.
Camden 2, N. J.

Corrections

Reference AVIATION WEEK, July 16, 1951, in your article and table on page 72, "U. S. Nonscheduled Airlines 1950 Operation," you show Airline Transport Carriers, Inc., as "D," or "disapproved."

Airline Transport Carriers, Inc., was granted an individual exemption by the Civil Aeronautics Board effective July 3, 1951, to continue large irregular carrier activities for two years.

We appreciate that the data on your table or chart might have been compiled prior to the approval date of this exemption, in which case your notations should have shown our company as "NA," or "no action." However, at no time has Airline Transport Carriers', Inc., application been disapproved. Consequently, we would greatly appreciate a correction on the above in your next publication.

A. F. KNOCHE, Secretary-Treasurer
Airline Transport Carriers, Inc.
Lockheed Air Terminal
Burbank, Calif.

(As previously noted Aug. 6, page 8, the error was made by the Air Coach Transport Assn. in an exhibit prepared for Capitol Hill.—Ed.)

It has been called to my attention that the folowing statement was published in AVIATION WEEK . . .

"Maj. Gen. Kenneth P. McNaughton, USAF, will retire soon to a farm at Middleburg, Va. Current assignment is Deputy Commanding General for Air Training Command, Scott Air Force Base, Illinois."

I wish to inform you that I have no intention of retiring now or in the near future.

MAJ. GEN. K. P. McNAUGHTON, USAF
Vice Commander
Air Training Command
Scott AFB, Ill.

Praise

. . . We are very pleased with the fine article which appeared in AVIATION WEEK recently on the new control system which has been developed by Dr. Frederick W. Ross of our aeronautical engineering faculty. We wish to extend our appreciation for the cordial and efficient handling of the matter by your technical staff.

C. J. STEINER, S. J., President
University of Detroit
McNichols Road at Livernois
Detroit 21.

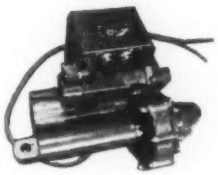
(Editor Robert E. Wood, whose editorials usually appear on this page, is on vacation.)

EEMCO technical bulletin

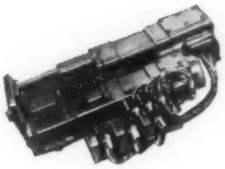
MOTOR ACTUATORS FOR AUTOMATIC FLIGHT

Today's aircraft fly on the edge of human capabilities and endurance. A transition from conventional piloted aircraft to pilotless types is taking place. The development of foolproof power units to actuate controls is a primary factor in the achievement of automatic flight. These units are being designed and produced by EEMCO in close cooperation with the builders of tomorrow's aircraft.

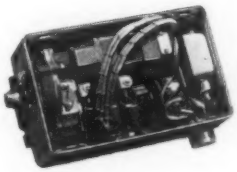
Rotary Actuator for Rugged Duty This Rotary Actuator was designed for trim tab actuation in a long range bomber involving the most rugged duty cycle. It operates almost continuously with the automatic pilot. Required duty cycle is one second full load, one second off and one second full load in opposite direction, continuous. Silicone insulated and high temperature materials used throughout.



Stabilizer Actuator for Large Jet Fighters This unit incorporates two motors of different size, driving into individual gear reductions to operate the screw jack. Small motor of 1/10 h. p. output operates almost continuously with automatic pilot. The large intermittent duty 3.3 h. p. motor provides manual operation of screw jack by pilot for maneuvering.



Double Motor Power Unit This unconventional system operates the horizontal stabilizer on a turbo prop aircraft of recent design. A small continuous duty motor of 1/15th h. p. operates through a gear reduction in conjunction with automatic pilot. Large intermittent duty 3½ h. p. motor with direct drive of 12,000 rpm is used for manual operation.



Rotary Actuator Package This system provides manual or automatic pilot elevator operation on one of the latest jet fighters. Totally enclosed in box equipped with mounting bracket it incorporates motor, magnetic clutch, radio noise filter and brake. Gear reduction, and auxiliary gear reduction operate adjustable travel limit switches and position indicator. Output rpm at 3 inch – pounds loads, 2500. Weight, complete, 3¾ pounds.

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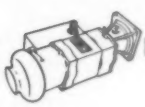
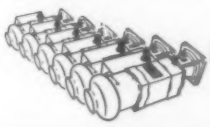
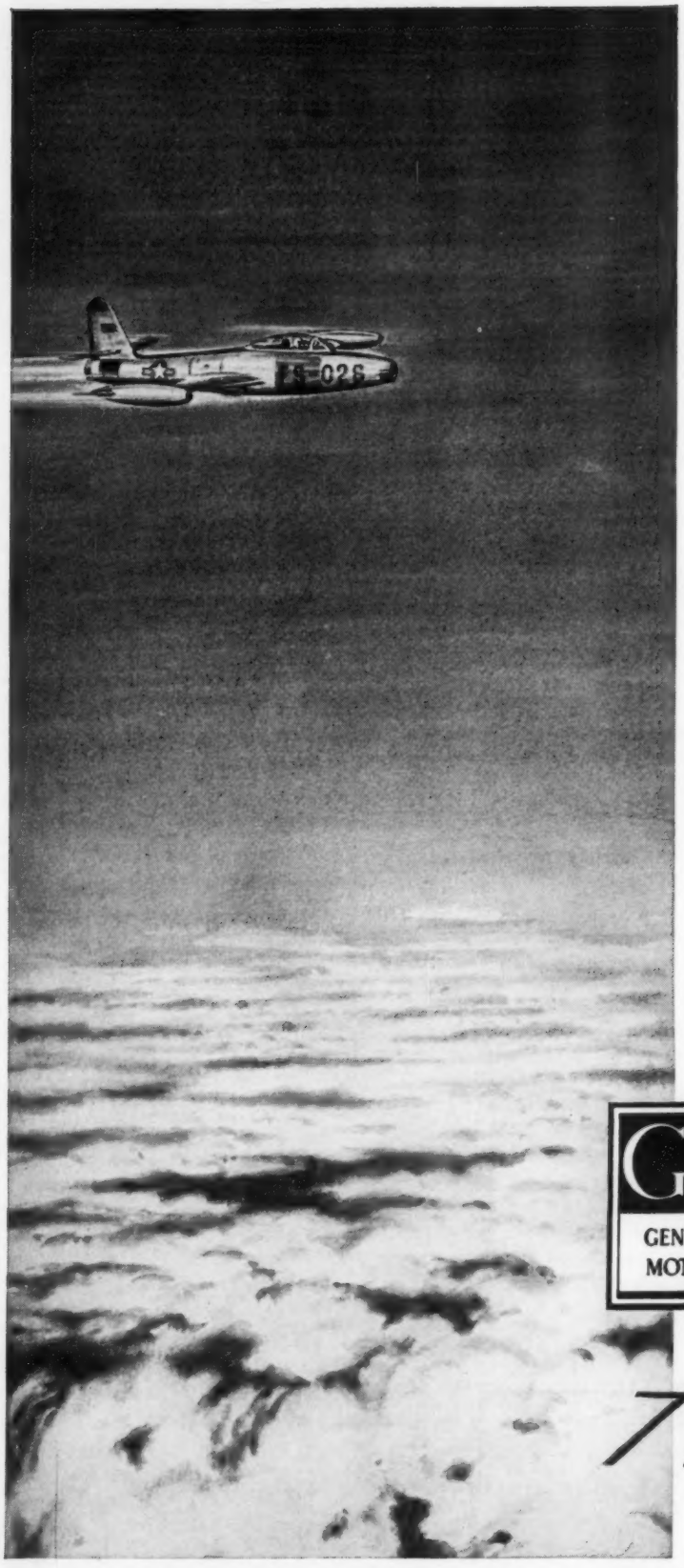
SPECIAL MOTOR DESIGN



DEVELOPMENT



MANUFACTURING



Sweeping past the 1,000,000th hour

OVER a target in Korea, on a flight from an American base — at home, in Alaska, in Japan or somewhere in Europe, or from the deck of a Navy carrier, an unknown jet pilot has just made aviation history.

Reports just tabulated from fighter squadrons all over the world record that Allison-powered jets recently swept past the 1,000,000th hour mark to establish another "*first*" for these famous Allison J33 and J35 Turbo-Jet Engines.

More than 10,000 of these high-powered, battle-proved engines are piling up a record of availability and reliability never before equaled. They lead the world in experience—in actual time in the air. And, even more important these Allision engines have met *and have exceeded* every military specification for operation and performance—*under the stern test of combat!*

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Builders of J35 Axial, J33 Centrifugal Flow Turbine Engines, the J35-A-23 Super-Jet and T40 Turbo-Prop Engines

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